# APPENDIX A
## Supplemental Sediment Investigation Report

# Updated Supplemental Sediment Investigation Report

R.G. Haley International Site
Bellingham, Washington

*for*
**City of Bellingham**

December 28, 2023

GeoEngineers
Earth Science + Technology

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GeoEngineers

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# R.G. Haley International Site
# Bellingham, Washington

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**December 28, 2023**

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## 1.0 INTRODUCTION

In January 2018 a Supplemental Sediment Investigation Report (GeoEngineers 2018) was completed describing the results of supplemental sediment investigations (SSIs) conducted on behalf of the City of Bellingham (City) to address data gaps identified in the Remedial Investigation Report (RI) and Feasibility Study (FS) Report (GeoEngineers 2016a,b) for the marine unit of the R.G. Haley International (Haley) Site (Figure 1). The marine unit includes contaminated intertidal and subtidal aquatic lands adjacent to the upland unit of the Site.)

The investigations were performed to resolve the following data gaps in the marine unit:

- The northern and southern extent of nearshore sediment that exceeds chemical and biological criteria based on benthic toxicity, and
- The bayward extent of dioxins/furans, carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and pentachlorophenol (PCP) in sediment that exceeds criteria based on bioaccumulative effects.

Three phases of sampling were conducted after completion of the RI sediment investigation in 2012 to address these data gaps at intertidal and subtidal locations. The scope and approach for each of these sampling events were documented in two work plans and a sampling and analysis plan (SAP) reviewed and approved by Washington State Department of Ecology (Ecology) (GeoEngineers 2013, 2015 and 2016c). In addition, surface sediment samples obtained and archived by the Port of Bellingham (Port) to support remedial design of the adjacent Cornwall Avenue Landfill site (Landau 2016) were submitted for analysis of dioxins/furans to augment the Haley RI data set.

Since completion of the 2018 Supplemental Sediment Investigation Report, a Cleanup Action Plan (CAP; Ecology 2018) and an Engineering Design Report (EDR; GeoEngineers 2022) have been completed. The CAP includes sediment cleanup levels (CULs) for indicator hazardous substances[1] (IHSs) and the EDR includes updated sediment CULs for dioxins/furans and cPAHs. This 2023 Supplemental Sediment Investigation Report updates the 2018 Supplemental Sediment Investigation Report to reflect these CULs in support of Ecology development of an updated CAP for the Haley Site.

### 1.1. Objectives

Components of the preferred sediment remedy as defined in the Haley FS (GeoEngineers 2016b) are illustrated in Figure 2. As indicated in the Haley RI/FS report (GeoEngineers 2016a,b), additional sediment data were needed to establish the limits of the marine unit and refine components of the sediment remedy throughout an expanded marine unit that was yet to be determined. Data collected during the SSIs were intended to fulfill these, and the following, more specific objectives:

- Confirm or refine the lateral extent of nearshore sediment removal and capping actions needed to address all sediment that exceeds chemical and/or biological criteria protective of the benthic community as defined in the Sediment Management Standards (SMS).
- Characterize the vertical extent of contamination in the same nearshore areas to support remedial design.

- Characterize the distribution of bioaccumulative compounds outside of the benthic toxicity exceedance area.
- Propose a marine unit boundary and expanded areas for remedy components in the marine unit.

Data and work products developed as part of the SSIs supported development of the CAP and subsequent EDR. This 2023 update to the Supplemental Sediment Investigation Report supports Ecology development of an updated CAP for the Haley Site.

### 1.2. Scope

The SSIs included the following activities:

- Collected and analyzed a total of seven intertidal surface (0 to 0.39 foot) sediment samples north and south of the benthic toxicity exceedance area identified in the FS (Figure 2). These samples included SSI-SS-01 through SSI-SS-03 to the south, and SSI-SS-04 through SSI-SS-07 to the north (Figure 3).
- Collected subsurface sediment samples from seven cores advanced to depths as great as 8 feet below mudline (bml) at approximately the same locations as the surface samples described above. The coring locations are identified as SSI-SC-01 through SSI-SC-07 (Figure 3). Initially analyzed the samples collected from the 0 to 2-foot and 2- to 4-foot depth intervals from each core and archived the remainder of the samples. Additional analyses were conducted at several locations from the 4- to 6-foot sample interval based on the initial results.
- Collected eight shallow (0- up to 2-feet bml) subsurface grab samples (COB-CC-C1, COB-CC-C2, PSB-SC-01 through PSB-SC-04) from the Pine Street Beach for analysis of bioaccumulative compounds. Two intervals (1- to 2- feet) at PSB-SC-01 and PSB-SC-04 were archived.
- Selected intertidal surface sediment samples for biological testing based on the initial chemical analytical results. Samples SSI-SS-03, SSI-SS-05 and SSI-SS-06 were submitted for this follow-up testing.
- Collected 11 subtidal surface (0 to 0.39 foot) sediment samples to evaluate the distribution of site-related bioaccumulative compounds in deeper water surrounding the nearshore benthic toxicity exceedance area. These samples are identified as SSI-SS-08 through SSI-SS-18 (Figure 3).
- Coordinated with the Port of Bellingham to analyze dioxins/furans in surface sediment samples collected for the Cornwall Avenue Landfill site. These samples are identified as CL-SG-1, CL-SG-3 and CL-SG-4 (Figure 3) and analytical results are incorporated in the summary tables of this (SSI) report.
- Validated and incorporated the SSI and Cornwall data into the Haley RI/FS database and submitted the data to Ecology's Environmental Information Management (EIM) system.

The sediment samples described above are summarized in Table 1. In general, the analytical program for these samples, which is summarized in Table 2, was structured to assess risks to the benthic community in nearshore samples, and risks to human and ecological health from bioaccumulative compounds throughout the marine unit.

## 2.0 SEDIMENT SAMPLING ACTIVITIES

To meet the SSI objectives, both surface and subsurface samples were collected from the marine unit. Two surface sediment composite[1] samples (COB-CC-C1 and COB-CC-C2) were collected on August 17, 2013 from the Pine Street Beach; surface grab and subsurface core samples from SSI-SS/SC-01 through SSI-SS/SC-07 and surface samples from SSI-SS-08 through SSI-SS-18 (Figure 3) were obtained between October 12 and 15, 2015 from throughout the Site. Surface (0- to 1-foot) and shallow subsurface (1- to 2-foot) grab samples (PSB-SC-01 through PSB-SC-04) were collected on February 18, 2016 from the Pine Street Beach and analyzed separately to confirm the 2013 composite sample results.

Surface sample depths were defined based on the receptors of concern. The sampling depth for evaluation of benthic community risks was the top 0.39 feet (12 centimeters [cm]) of sediment and is based on the biologically active zone established for Bellingham Bay; this depth interval was also used to evaluate risks to higher trophic level aquatic receptors and net-fishers where bioaccumulative compounds are the primary IHSs in the marine unit. The sampling depth interval for evaluation of human health risks associated with recreational clamming or beach play in the intertidal zone was defined in the FS as 0 to 1.5 feet. For the SSI, this depth was represented by the 0- to 2-foot interval. Deeper subsurface sediment in the intertidal zone were collected to a target depth of 8 feet bml (where possible) to evaluate nature and extent and to support future remedial design. This depth was selected based on the depth of contamination in nearby sediment core samples that were collected during prior phases of the RI.

Surface and subsurface sampling locations were co-located to the extent practicable. Most of the SSI samples were collected from a shallow-draft vessel using a power grab (in the case of surface sediment) or a vibracore (in the case of subsurface sediment). Intertidal surface and shallow subsurface sediment samples SSI-SS-02, SSI-SS-04, PSB-SC-01 through PSB-SC-04, and the composite samples COB-CC-C1 and COB-CC-C2 were collected by hand during a low tide. All sample location information is reported relative to NAD83/98 as the horizontal reference and NAVD88 for the vertical reference.

Details regarding sampling and analytical procedures and rationale are provided in the work plans and SAP (GeoEngineers 2013, 2015 and 2016c). Field logs, including core logs, along with photographs taken during field activities are provided in Appendix A and B, respectively.

### 2.1. Deviations from the Sampling and Analysis Plan

Samples were collected and analyzed in general accordance with the approved work plans and SAP (GeoEngineers 2013, 2015 and 2016c) with the following exceptions:

- The core sample at SSI-SC-02 could not be collected due to the presence of large rock and debris at this location, despite multiple attempts.
- The penetration depth was less than 8 feet due to refusal at the following cores:
    - SSI-SC-01 (6 feet)
    - SSI-SC-04 (4 feet)
    - SSI-SC-06 (7 feet)

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[1] The two 2013 samples were each composed of 0-to-1 foot sample intervals from three discrete locations from the Pine Street Beach. The sample material was collected by hand over an area 1-foot in diameter at each target location and then composited for analysis.

- The actual sampling location for SSI-SC-04 was offset from the target location by 7 meters (rather than 3 meters as identified in the work plan) due to multiple failed attempts at the target location because of the presence of large rock, concrete and debris.
- Due to the presence of boulders, large cobble and debris and general lack of fine-grained sediment (i.e., gravel or smaller), surface samples at SSI-SS-02 and SSI-SS-04 required hand-collection of sediment over an area approximately 5 feet in diameter to achieve the required sample volume.
- The surface sediment sample at SSI-SS-02 was analyzed for dioxins/furans to provide information at this location, since a core could not be collected.
- PCP was initially not detected in sample SSI-SS-09; however, the reported detection limit was elevated. Because data at this location were needed to confirm the bayward extent of PCP, the sample was reanalyzed by a different analytical method to achieve a lower detection limit.
- Minor deviations in test parameters for water temperature and salinity occurred during bioassay testing.

## 3.0 CHEMICAL AND BIOLOGICAL TESTING

The sampling and analytical testing program is summarized in Table 2. Chemical analyses were conducted by Ecology-certified laboratories. Analytical Resources Incorporated (ARI) in Tukwila, Washington analyzed the SMS suite of organic compounds and conventional parameters; dioxins/furans were analyzed by Frontier Analytical in El Dorado Hills, California. Ramboll Environ (Ramboll) conducted the bioassay testing. Samples were analyzed according to the work plans and SAP (GeoEngineers 2013, 2015 and 2016c) and followed the Puget Sound Estuary Program (PSEP; 1987, 1995 and 1997 with updates) protocol and Sediment Cleanup Users' Manual II (SCUM II) guidance (Ecology 2015).

### 3.1. Initial and Follow-up Analytical Testing

The analytical testing program was developed based on the study objectives (Section 1.1). Samples were analyzed for one or more of the following chemicals or chemical groups:

- SMS suite of semi-volatile organic compounds (SVOCs)
- Dioxins/furans
- cPAHs
- PCP
- Total petroleum hydrocarbons (TPH)
- Total organic carbon (TOC)
- Grain size
- Total solids

The analytical program for intertidal surface samples focused on evaluation of potential effects to the benthic invertebrate community by analyzing for the SMS suite of chemicals excluding metals, pesticides, and polychlorinated biphenyls, which were not site IHSs. Subtidal surface samples were analyzed for bioaccumulative IHSs to support the evaluation of human and ecological health risks. Subsurface samples collected from the intertidal zone were analyzed for bioaccumulative and SMS chemicals for the evaluation of health risks and to support remedy design.

Chemical analyses occurred in two phases: initial testing according to the work plans or SAP, and follow-up testing based on the initial results where needed to further evaluate the lateral and/or vertical extent of IHSs. Analysis of archived samples was triggered by an exceedance of the RI screening levels based on the protection of the benthic invertebrate community or preliminary CULs for bioaccumulative IHSs from the FS.

Surface sediment samples from SSI-SS-01 through SSI-SS-12 were initially analyzed and samples from SSI-SS-13 to SSI-SS-18 were archived. Based on the analytical results, SSI-SS-14, SSI-SS-15, and SSI-SS-16 were submitted for follow-up testing to more clearly establish the bayward extent of dioxins/furans. Additionally, SSI-SS-09 was analyzed for PCP to confirm the bayward extent of this IHS.

Subsurface samples from 0- to 2-feet and 2- to 4- feet bml were initially analyzed at locations SSI-SC-01 and SSI-SC-03 through SSI-SC-07. Based on initial results, archived samples from 4 to 6 feet bml at SSI-SC-05, SSI-SC-06 and SSI-SC-07 were tested for dioxins/furans and polycyclic aromatic hydrocarbons (PAHs). Other archived sample analyses included the 4 to 6 feet bml sample at SSI-SC-05 (for TPH) and the 4 to 6 feet bml sample at SSI-SC-06 (for PCP). Follow-up analysis of archived sediment samples was not necessary after initial analysis of discrete samples collected from 0-to-1- foot bml at PSB-SC-01 through PSB-SC-04, and the samples from 1 to 2 feet bml at PSB-SC-02 and PSB-SC-03.

All chemical data were validated according to the United States Environmental Protection Agency's (EPA's) Contract Laboratory Program National Functional Guidelines (EPA 2008, 2009 and 2011) prior to inclusion in the RI/FS database. A summary of the validation results is provided in Appendix C; validation details are provided in the attachments (C-1 and C-2).

### 3.2. Toxicity Testing

In accordance with the 2015 work plan, initial chemical results for the intertidal surface samples were evaluated to determine if bioassay testing would be required.

Bioassays included:

- 10-day adult amphipod (*Eohaustorius estuarius*) mortality test (acute toxicity),
- Sediment bivalve (*Mytilus galloprovincialis*) larval test (acute toxicity), and
- 20-day juvenile polychaete (*Neanthes arenaceodentata*) growth test (chronic toxicity).

Samples exceeding RI screening levels based on the protection of the benthic community were submitted for a suite of toxicity testing. Based on these criteria, SSI-SS-03 and SSI-SS-05 were submitted for toxicity testing. Although not exceeding screening levels, Ecology requested that sample SSI-SS-06 also be submitted for toxicity testing.

## 4.0 ANALYTICAL RESULTS

This section presents the analytical results organized according to the SSI objectives. Results related to delineation of the area of toxicity to the benthic community according to SMS regulation are presented first, followed by results that were used to establish the limit of SMS exceedances in subsurface sediment, and finally results used to determine the extent of bioaccumulative risks for people and higher-order aquatic receptors. Analytical results supporting the SMS benthic toxicity evaluation and subsurface extent of contamination are provided in Table 3; analytical results for bioaccumulative IHSs are presented in Table 4. Although not discussed in this report, summary statistics for the entire updated RI data set are provided in Appendix D.

### 4.1. SMS Chemicals

Benthic toxicity was initially evaluated by comparing chemical analytical results from the seven intertidal surface samples to the screening levels based on the promulgated SMS criteria or the equivalent Apparent Effects Thresholds (AETs; expressed on a dry-weight basis). The site-specific toxicity-based screening level for TPH was also used in this evaluation.

The results of the SMS chemical evaluation for intertidal surface sediment are shown in Figure 4; results are color-coded to indicate the greatest level of exceedance for each chemical group (low-molecular weight PAHs [LPAHs], high-molecular-weight PAHs [HPAHs], TPH, phenols, chlorinated benzenes, phthalates, and miscellaneous organic compounds). Only two surface samples exceeded benthic criteria: SSI-SS-03 exceeded for TPH and 2,4-dimethylphenol, and SSI-SS-05 exceeded for LPAHs, PCP and one chlorinated benzene. Sample SSI-SS-03 was located within the Cornwall Avenue Landfill Management Unit 2 (MU-2); sample SSI-SS-05 was north of the Haley benthic exceedance area identified in the RI/FS. The detection limits for several chlorinated benzenes were slightly greater than benthic criteria when normalized to TOC (SSI-SS-01, SSI-SS-02, SSI-SS-04, SSI-SS-05 and SSI-SS-07); however, no exceedances occurred when evaluated on a dry-weight basis (the original basis of the detection limit).

Three different bioassays (two acute and one chronic) were conducted on each of the three surface sediment samples and one reference sediment sample. Bioassay testing protocol requires a reference sediment with grain size matching that of the samples to be tested to factor out sediment grain-size effects on bioassay organisms. Reference sediment was collected by Ramboll from CR22 in Carr Inlet. Grain size was estimated in the field using a wet-sieve analysis of the reference sample to determine a match with the laboratory grain size results for the three samples from the Haley Site; reference sample grain size was later confirmed by laboratory analyses following PSEP protocol. Grain size characteristics (based on laboratory results) of the reference sample relative to the Site samples are provided below.

**SAMPLE AND REFERENCE GRAIN SIZE COMPARISON**

| Sample | Percent Fines (%) |
|---|---|
| CR22 (Reference) | 31 |
| SSI-SS-03_0-12 | 26 |
| SSI-SS-05_0-12 | 19 |
| SSI-SS-06_0-12 | 28 |

Bioassay results are summarized in Table 5 and are shown on Figure 5; individual test results are provided in Tables 6, 7 and 8. Ramboll's laboratory report is included as Appendix E. All results passed SMS biological effects criteria indicating that impacts to the benthic community from sediment contamination at the locations tested are unlikely. These results confirm the benthic toxicity exceedance area identified in the Haley RI/FS.

Subsurface data from intertidal sediment samples were also compared to benthic chemical criteria to support remedial design. The results are presented in Figure 6; color coding by chemical group is the same as in Figure 4. No benthic criteria were exceeded in the shallowest (0- to 2-foot) interval in three of the six cores sampled (SSI-SC-01, SSI-SC-06 and SSI-SC-07); PAHs and TPH concentrations exceeded benthic criteria in the three other cores (SSI-SC-03, SSI-SC-04 and SSI-SC-05). All the 2- to 4-foot core intervals had exceedances of PAHs, except for the two cores collected in the Cornwall Avenue Landfill MU-2. SSI-SC-05_2-4 sample also exceeded the TPH criterion. The two northern-most cores (SSI-SC-06 and SSI-SC-07) were the only cores with benthic criteria exceedances in the 4- to 6- foot bml samples; PAHs were the chemicals exceeding their respective criteria. These data are sufficient to support remedy design in the nearshore area to address risks to the benthic community.

## 4.2. Bioaccumulative Chemicals

Data collected as part of the SSIs are presented here to address the extent of dioxins/furans, cPAHs and PCP that was not resolved in the RI/FS. Table 4 presents the bioaccumulative IHS results for surface and subsurface samples.

### 4.2.1. Dioxins/Furans

Due to bay-wide elevated dioxin/furan concentrations with multiple sources, the footprint of the marine unit is defined by the extent of dioxin/furan concentrations exceeding the regional background concentration of 15 nanograms per kilogram (ng/kg) toxicity equivalent (TEQ), while the CUL of 13 ng/kg TEQ (GeoEngineers 2022) will be applied across the marine unit.

Dioxin/furan concentrations detected in the SSI surface sediment samples (Figure 7) ranged from 15.4 ng/kg TEQ (SSI-SS-08) to 52.2 ng/kg TEQ (CL-SG-04). SSI-SS-08 was collected west of the Pine Street Beach and CL-SG-04 was collected in Cornwall Avenue Landfill MU-2. Although all surface samples exceeded the regional background concentration of 15 ng/kg TEQ, the concentrations of dioxins/furans in subtidal surface sediment samples decreased in a southerly direction and in a westerly direction toward Whatcom Waterway. Dioxin/furan concentrations were less than the regional background concentration in samples previously collected by others from the Whatcom Waterway. The SSI data, combined with previously collected data, provide a sufficient basis to estimate the surface sediment area over which dioxin/furan concentrations exceed the regional background concentration.

Dioxin/furan concentrations in intertidal subsurface sediment samples (Figure 8) ranged from 2.9 ng/kg TEQ (SSI-SC-05_4-6) to 608 ng/kg TEQ (SSI-SC-06_2-4). Of the 23 subsurface samples analyzed from 12 locations, all but three exceeded the CUL (PSB-02_0-1 and PSB-03_0-1 from Pine Street Beach, and SSI-SC-05_4-6 south of Pine Street Beach). The majority of the 2015/2016 subsurface sediment dioxin/furan concentrations were less than three times the CUL. Samples collected from the upper intertidal area of the Pine Street Beach (PSB-SC-01 through PSB-SC-04, COB-CC-C1 and COB-CC-C2) had among the lowest dioxin/furan concentrations; the highest dioxin/furan concentrations, however, were detected in the lowest intertidal portion of Pine Street Beach (SSI-SC-06). Subsurface intertidal sediment data are sufficient to support expansion of the nearshore remedy to address dioxins/furans in the Pine Street Beach area.

### 4.2.2. Carcinogenic PAHs

The SSI surface sediment cPAH concentrations (Figure 9) ranged from 13 micrograms per kilogram (µg/kg) TEQ to 1,140 µg/kg TEQ, with only three of the 11 post-RI samples exceeding the CUL of 229 µg/kg TEQ (GeoEngineers 2022). Samples with concentrations exceeding the CUL were located within the nearshore area adjacent to the upland unit; cPAHs in offshore surface sediment samples collected to the south were less than the CUL of 229 µg/kg TEQ.

Exceedances of the CUL in subsurface samples were more frequent. Subsurface cPAH TEQ concentrations (Figure 10) ranged from 4 µg/kg TEQ to 1,000 µg/kg TEQ with 11 of the 21 samples analyzed (from 10 locations) exceeding the CUL. The Pine Street Beach shallow subsurface sediment samples (PSB-SC-01 through PSB-SC-04) represented the lowest concentrations (4.4 µg/kg TEQ to 38.3 µg/kg TEQ) and all were less than the CUL. The highest concentration was detected at SSI-SC-05 in the 0- to 2-foot sample interval. Concentrations were also elevated in the 2- to 4-foot bml sample in several other cores (SSI-SC-05 through SSI-SC-07). All subsurface exceedances of cPAHs co-occurred with dioxins/furans exceedances of the CUL.

The previously collected RI data in concert with the SSI data identify the bayward extent of cPAH concentrations exceeding the CUL. Elevated concentrations of cPAHs are present in sediment in the nearshore area adjacent to the upland unit in the Pine Street Beach area and at a location further west along the shoreline (Figure 9). These areas coincide with the site of the former Sehome Dock and other historical features, including the Port's present-day barge dock associated with the Bellingham Shipping Terminal. The former Sehome Dock was a large over-water freight wharf that included rail and warehouse facilities operated by Bellingham Bay and British Columbia Railroad Company and other companies (Figures F-1 and F-2; Appendix F). Historic overwater features also existed along the present-day shoreline west of Pine Street Beach. These included the Pine Street Trestle and City Wharf (precursor to the Bellingham Shipping Terminal Figure F-3). Further development of the Bellingham Shipping Terminal occurred on filled land that produced the present-day upland between Pine Street Beach and Whatcom Waterway. A composite view of historical nearshore and over-water features is presented in Figure F-4. The outlines of these historical features are also shown in Figure 9 (and Figure 14). It is likely that the nearshore area from Pine Street Beach to Whatcom Waterway was impacted by these historical activities as well as the over-water structures that supported these activities since the late 1800s.

Sediment analytical data also suggest that PAHs along the shoreline west of Pine Street Beach originated from a non-Haley source (Appendix G). The PAH profile of Haley-related chemicals is reflected by analytical data from samples RI-1 through RI-5 (Figures G-1 through G-5), which were collected immediately adjacent to the former Haley facility in an area impacted by the release of wood treatment chemicals. The profile of PAHs in sediment west of Pine Street Beach (Port barge dock area) is reflected in samples 6B-01-SS, 6C-01-SS, and 6C-02-SS (Figures G-6 through G-8). PAH profiles are similar within each of these areas but differ between the areas. In general, lighter molecular weight PAHs (naphthalene through anthracene) are more prevalent in sediment adjacent to the Haley facility than west of Pine Street Beach. PAH ratios are commonly used to evaluate sources and the most common ratio is fluoranthene:pyrene (F/P). This ratio is commonly used because these PAHs are typically abundant, behave similarly in the environment and resist weathering. Differences in F/P ratios, therefore, are more apt to reflect different sources as opposed to the effects of environmental fate and transport. The F/P ratio in all samples adjacent to the former Haley facility are <1, as opposed to samples collected west of Pine Street Beach which are all >1. Another obvious difference is the relative abundance of dibenzo(a,h)anthracene compared to indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene in samples from the two areas. Dibenzo(a,h)anthracene is less abundant than the other two compounds in the Haley samples, and more abundant than the other compounds in samples west of Pine Street Beach.

PAHs in samples COB-SS-04 and COB-SS-05 appear to represent mixed sources (Figures G-9 and G-10). These samples were collected at the location of the subtidal cPAH hot spot near Pine Street Beach (Figure 14). These samples exhibit some similarity to the Haley samples based on the relative abundance of light molecular weight PAHs; however, the F/P ratio in these samples resembles sediment in the Port barge dock area. Another diagnostic ratio used to evaluate PAH sources is anthracene:phenanthrene. The anthracene:phenanthrene ratio is considerably lower in the subtidal Pine Street Beach samples than either the Haley or Port barge dock samples.

The elevated cPAH concentrations in the Pine Street Beach area fall within the footprint of dioxins/furans that will be actively remediated as part of the Haley cleanup. The elevated cPAH concentration near the Bellingham Shipping Terminal barge dock is within the footprint of the proposed cap and armoring that will be constructed as part of the cleanup of Whatcom Waterway Phase 2 Areas. Concentrations of cPAHs between these locations are less than the CUL.

#### 4.2.3. Pentachlorophenol

PCP concentrations in SSI surface sediment samples (Figure 11) ranged from non-detect (85U µg/kg) to 580 µg/kg. Three of the eight sediment samples exceeded the CUL of 100 µg/kg (Ecology 2018). All surface sediment sample exceedances occurred in the intertidal area and fell within the footprint of dioxin/furan and cPAH exceedances.

Concentrations of PCP in subsurface sediment samples ranged from 12 µg/kg to 250 µg/kg (Figure 12); only four of the 19 samples analyzed exceeded the CUL. The Pine Street Beach samples represented the lowest concentrations (12 µg/kg to 33 µg/kg); all were below the CUL. The highest concentration occurred at SSI-SC-06 in the 2-to-4-foot bml sample interval (250 µg/kg). All subsurface sediment sample exceedances occurred in the intertidal area and fell within the footprint of dioxin/furan and cPAH exceedances.

## 5.0 DISCUSSION

Data presented in this report provide the necessary information for Ecology development of an updated CAP for the Haley Site. The nearshore SSI chemical and biological data confirm that the benthic toxicity exceedance area does not extend further north or south than shown in the RI/FS. As a result, the nearshore sediment removal and capping components of the preferred remedy are expected to fully address risks to the benthic community.

The SSI data also adequately characterize the extent of bioaccumulative compounds. The spatial distribution of dioxins/furans, cPAHs and PCP in surface sediment were interpolated using an inverse-distance weighted model (Figures 13, 14 and 15, respectively). For each constituent, the geographic information system (GIS)-based model displays data for four different concentration intervals. The upper limit of each interval is set at the following approximate concentrations: the CUL, about 3.5 times the CUL, about 8 times the CUL, and greater than 8 times the CUL.

GIS interpolation models are affected by the density of the data and the magnitude of the known concentrations. The models interpolate data far beyond the last meaningful control point when data are sparse. For this reason, the outer boundary of the interpolated data was manually selected based on a practical interpretation of the data. For instance, the southern 15 ng/kg dioxin/furan concentration boundary was selected closer to samples CL-SG-1, SSI-SS-12, and SSI-SS-16 than the GIS model would otherwise indicate. Dioxin/furan concentrations in these samples are 15.5, 16.9 and 15.5 ng/kg, respectively. These values only very slightly exceed the regional background value of 15 ng/kg. However, given the wide spacing in data points, the true location of the 15 ng/kg boundary line may in some locations vary several hundred feet landward or seaward from its interpolated position.

The dioxin/furan footprint in surface sediment encompasses the cPAH and PCP footprints when compared to their respective CULs (Figures 13, 14 and 15). The distribution of dioxins/furans can therefore be used to establish the marine unit boundary.

The footprint of bioaccumulative compounds is considerably larger than the spatial extent of the preferred sediment remedy shown in the Haley FS. This was anticipated at the time the FS was prepared and s reflected in the cleanup documents generated since completion of the SSI's. The footprint of bioaccumulative compounds also overlaps with remedial action areas associated with the adjacent Whatcom Waterway and Cornwall Landfill cleanups.

## 6.0 LIMITATIONS

We have prepared this report for the City of Bellingham (City) for the R.G. Haley International Site as an addendum to the remedial investigation and feasibility study. The City may distribute copies of this report to regulatory agencies as may be required for the project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for environmental investigations in this area at the time this report was prepared.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments should be considered a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

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# Table 1

## Sample Locations

R.G. Haley Site

Bellingham, Washington

| Sample Location[1] | Sample Identification | Date Sampled | Sample Coordinates[2] Washington State Planes (NAD83) | | Water Surface Elevation (ft NAVD88) | Depth of Water Column (ft) | Mudline Elevation (ft NAVD88) | Sampling Method | Penetration Depth (ft below mudline) | Sample Interval (below mud line) | | Elevation at Top of Sample (ft NAVD88) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Easting | Northing | | | | | | Top (ft) | Bottom (ft) | |
| SSI-SS-01 | SSI-SS-01-0-12 | 10/15/2015 | 1239699.93 | 639393.98 | 4.31 | 9.50 | -5.24 | Power Grab | 0.30 | 0 | 0.3 | -5.24 |
| | SSI-SS-DUP-03 | 10/15/2015 | 1239699.93 | 639393.98 | 4.31 | 9.50 | -5.24 | | | 0 | 0.3 | -5.24 |
| SSI-SS-02 | SSI-SS-02_0-12 | 10/15/2015 | 1239821.87 | 639346.08 | 3.51 | 0.00 | 3.51 | Hand-collected | 0.39 | 0 | 0.39 | 3.51 |
| SSI-SS-03 | SSI-SS-03_0-12 | 10/15/2015 | 1239771.03 | 639465.48 | 4.51 | 12.80 | -8.29 | Power Grab | 0.69 | 0 | 0.39 | -8.29 |
| SSI-SS-04 | SSI-SS-04_0-12 | 10/15/2015 | 1240507.51 | 639802.05 | 2.51 | 0.00 | 2.51 | Hand-collected | 0.39 | 0 | 0.39 | 2.51 |
| SSI-SS-05 | SSI-SS-05_0-12 | 10/12/2015 | 1240424.93 | 639823.96 | 2.91 | 7.80 | -4.89 | Power Grab | 0.46 | 0 | 0.39 | -4.89 |
| SSI-SS-06 | SSI-SS-06_0-12 | 10/12/2015 | 1240485.55 | 639964.27 | 3.21 | 8.70 | -5.49 | Power Grab | 0.56 | 0 | 0.39 | -5.49 |
| SSI-SS-07 | SSI-SS-07_0-12 | 10/12/2015 | 1240451.56 | 640149.78 | 3.71 | 7.40 | -3.69 | Power Grab | 0.43 | 0 | 0.39 | -3.69 |
| SSI-SS-08 | SSI-SS-08_0-12 | 10/12/2015 | 1240062.51 | 640265.96 | 4.51 | 26.50 | -21.99 | Power Grab | 0.79 | 0 | 0.39 | -21.99 |
| SSI-SS-09 | SSI-SS-09_0-12 | 10/12/2015 | 1239630.95 | 639725.00 | 4.61 | 21.50 | -16.89 | Power Grab | 0.75 | 0 | 0.39 | -16.89 |
| SSI-SS-10 | SSI-SS-10_0-12 | 10/12/2015 | 1239203.19 | 639263.41 | 5.31 | 28.80 | -23.49 | Power Grab | 0.46 | 0 | 0.39 | -23.49 |
| SSI-SS-11 | SSI-SS-11_0-12 | 10/12/2015 | 1238821.87 | 638767.28 | 7.41 | 30.10 | -22.69 | Power Grab | 0.72 | 0 | 0.39 | -22.69 |
| SSI-SS-12 | SSI-SS-12_0-12 | 10/12/2015 | 1238699.52 | 638349.08 | 4.51 | 29.60 | -25.09 | Power Grab | 0.69 | 0 | 0.39 | -25.09 |
| SSI-SS-13 | SSI-SS-13_0-12 | 10/12/2015 | 1239637.27 | 640607.96 | 7.01 | 33.30 | -26.29 | Power Grab | 0.72 | 0 | 0.39 | -26.29 |
| | SSI-SS-DUP-01 | 10/12/2015 | 1239637.27 | 640607.96 | 7.01 | 33.30 | -26.29 | | | 0 | 0.39 | -26.29 |
| SSI-SS-14 | SSI-SS-14_0-12 | 10/13/2015 | 1239617.14 | 640203.43 | 6.01 | 27.40 | -21.39 | Power Grab | 0.52 | 0 | 0.39 | -21.39 |
| SSI-SS-15 | SSI-SS-15_0-12 | 10/13/2015 | 1239228.96 | 639802.28 | 5.71 | 29.40 | -23.69 | Power Grab | 0.46 | 0 | 0.39 | -23.69 |
| SSI-SS-16 | SSI-SS-16_0-12 | 10/13/2015 | 1238508.27 | 639067.91 | 4.81 | 30.40 | -25.59 | Power Grab | 0.46 | 0 | 0.39 | -25.59 |
| SSI-SS-17 | SSI-SS-17_0-12 | 10/13/2015 | 1239120.49 | 640318.04 | 4.51 | 32.30 | -27.79 | Power Grab | 0.59 | 0 | 0.39 | -27.79 |
| SSI-SS-18 | SSI-SS-18_0-12 | 10/13/2015 | 1238808.66 | 639768.38 | 3.61 | 28.10 | -24.49 | Power Grab | 0.46 | 0 | 0.39 | -24.49 |
| | SSI-SS-DUP-02 | 10/13/2015 | 1238808.66 | 639768.38 | 3.61 | 28.10 | -24.49 | | | 0 | 0.39 | -24.49 |
| SSI-SC-01 | SSI-SC-01_0-2 | 10/14/2015 | 1239695.34 | 639367.68 | 4.51 | 10.40 | -5.89 | Vibracore | 6.0 | 0 | 2.0 | -5.89 |
| | SSI-SC-DUP-01 | 10/14/2015 | | | | | | | | 0 | 2.0 | -5.89 |
| | SSI-SC-01_2-4 | 10/14/2015 | | | | | | | | 2 | 4.0 | -7.89 |
| | SSI-SC-01_4-6 | 10/14/2015 | | | | | | | | 4 | 6.0 | -9.89 |
| SSI-SC-02[3] | Abandoned | Abandoned | 1239814.39[3] | 639375.35[3] | -- | -- | -- | -- | -- | -- | -- | -- |
| SSI-SC-03 | SSI-SC-03_0-2 | 10/14/2015 | 1239788.45 | 639426.59 | 4.51 | 7.60 | -3.09 | Vibracore | 8.0 | 0 | 2.0 | -3.09 |
| | SSI-SC-03_2-4 | 10/14/2015 | | | | | | | | 2 | 4.0 | -5.09 |
| | SSI-SC-03_4-6 | 10/14/2015 | | | | | | | | 4 | 6.0 | -7.09 |
| | SSI-SC-DUP-02 | 10/14/2015 | | | | | | | | 4 | 6.0 | -7.09 |
| | SSI-SC-03_6-8 | 10/14/2015 | | | | | | | | 6 | 8.0 | -9.09 |

| Sample Location[1] | Sample Identification | Date Sampled | Sample Coordinates[2] Washington State Planes (NAD83) Easting | Northing | Water Surface Elevation (ft NAVD88) | Depth of Water Column (ft) | Mudline Elevation (ft NAVD88) | Sampling Method | Penetration Depth (ft below mudline) | Sample Interval (below mud line) Top (ft) | Bottom (ft) | Elevation at Top of Sample (ft NAVD88) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSI-SC-04 | SSI-SC-04_0-2 | 10/15/2015 | 1240482.54 | 639785.46 | 7.31 | 6.90 | 0.41 | Vibracore | 4.0 | 0 | 2.0 | 0.41 |
| | SSI-SC-DUP-03 | 10/15/2015 | | | | | | | | 0 | 2.0 | 0.41 |
| | SSI-SC-04_2-4 | 10/15/2015 | | | | | | | | 2 | 4.0 | -1.59 |
| SSI-SC-05 | SSI-SC-05_0-2 | 10/13/2015 | 1240432.94 | 639831.19 | 6.01 | 9.50 | -3.49 | Vibracore | 8.0 | 0 | 2.0 | -3.49 |
| | SSI-SC-05_2-4 | 10/13/2015 | | | | | | | | 2 | 4.0 | -5.49 |
| | SSI-SC-05_4-6 | 10/13/2015 | | | | | | | | 4 | 6.0 | -7.49 |
| | SSI-SC-05_6-8 | 10/13/2015 | | | | | | | | 6 | 8.0 | -9.49 |
| SSI-SC-06 | SSI-SC-06_0-2 | 10/13/2015 | 1240514.26 | 639964.40 | 4.01 | 6.80 | -2.79 | Vibracore | 7.0 | 0 | 2.0 | -2.79 |
| | SSI-SC-06_2-4 | 10/13/2015 | | | | | | | | 2 | 4.0 | -4.79 |
| | SSI-SC-06_4-6 | 10/13/2015 | | | | | | | | 4 | 6.0 | -6.79 |
| | SSI-SC-06_6-7 | 10/13/2015 | | | | | | | | 6 | 7.0 | -8.79 |
| SSI-SC-07 | SSI-SC-07_0-2 | 10/13/2015 | 1240430.59 | 640152.61 | 4.91 | 8.20 | -3.29 | Vibracore | 8.0 | 0 | 2.0 | -3.29 |
| | SSI-SC-DUP-04 | 10/13/2015 | | | | | | | | 0 | 2.0 | -3.29 |
| | SSI-SC-07_2-4 | 10/13/2015 | | | | | | | | 2 | 4.0 | -5.29 |
| | SSI-SC-07_4-6 | 10/13/2015 | | | | | | | | 4 | 6.0 | -7.29 |
| | SSI-SC-07_6-8 | 10/13/2015 | | | | | | | | 6 | 8.0 | -9.29 |
| PSB-SC-01 | PSB-SC-01-0-1 | 2/18/2016 | 1240606.78 | 639879.16 | 4.33 | 0.00 | 4.33 | Hand-collected | 2.0 | 0 | 1.0 | 4.33 |
| | PSB-SC-01-1-2 | 2/18/2016 | | | | | | | | 1 | 2.0 | 3.33 |
| PSB-SC-02 | PSB-SC-02-0-1 | 2/18/2016 | 1240583.96 | 639961.75 | 1.31 | 0.00 | 1.31 | Hand-collected | 2.0 | 0 | 1.0 | 1.31 |
| | PSB-SC-02-1-2 | 2/18/2016 | | | | | | | | 1 | 2.0 | 0.31 |
| PSB-SC-03 | PSB-SC-03-0-1 | 2/18/2016 | 1240637.16 | 639963.99 | 6.11 | 0.00 | 6.11 | Hand-collected | 2.0 | 0 | 1.0 | 6.11 |
| | PSB-SC-03-1-2 | 2/18/2016 | | | | | | | | 1 | 2.0 | 5.11 |
| PSB-SC-04 | PSB-SC-04-0-1 | 2/18/2016 | 1240607.72 | 640040.70 | 4.71 | 0.00 | 4.71 | Hand-collected | 2.0 | 0 | 1.0 | 4.71 |
| | PSB-SC-04-1-2 | 2/18/2016 | | | | | | | | 1 | 2.0 | 3.71 |
| CL-SG-1 | CL-SG-1_0-10 | 6/10/2015 | 1239046.85 | 638088.18 | 4.61 | 13.90 | -9.29 | Power Grab | NR | 0 | 0.33 | -9.29 |
| CL-SG-3 | CL-SG-3_0-10 | 6/10/2015 | 1239171.17 | 638823.80 | 4.11 | 21.00 | -16.89 | Power Grab | NR | 0 | 0.33 | -16.89 |
| CL-SG-4 | CL-SG-4_0-10 | 6/10/2015 | 1239423.47 | 639210.89 | 3.21 | 20.00 | -16.79 | Power Grab | NR | 0 | 0.33 | -16.79 |
| COB-CC-C1[4] | COB-CC-C1_0-1 | 8/17/2013 | 1240608.64 | 639939.70 | -0.78 to 8.45 | 0.00 | -0.78 to 8.45 | Hand-collected | 1.0 | 0 | 1.0 | -0.78 to 8.45 |
| COB-CC-C2[4] | COB-CC-C2_0-1 | 8/17/2013 | 1240602.86 | 640011.43 | -0.75 to 8.83 | 0.00 | -0.75 to 8.83 | Hand-collected | 1.0 | 0 | 1.0 | -0.75 to 8.83 |

**Notes:**

[1] Sediment sample locations shown on Figure 3.

[2] Obtained using a real time kinematic (RTK) - global positioning system (GPS) and/or hand-held Trimble GPS device.

[3] Sample location abandoned after multiple refusals. Coordinates are for proposed location.

[4] Composite samples, reporting Easting and Northings centroid and elevations range.

ft = feet

NR = not reported

# Table 2

## Summary of Analyses

R.G. Haley Site
Bellingham, Washington

| Location Description | Sample Location | Sample Interval (depth below mud line in feet) | Sampling Method | Analysis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dioxins/ Furans | Total Organic Carbon | Total Solids | Grain Size | SVOCs | cPAHs | Chlorophenols | TPH (Diesel- and Heavy Oil-Range) | Bioassay |
| | | | | EPA Method 1613 Mod | Plumb 1981, Standard Method 5310B or SW846 Method 9060 | PSEP 1986 | PSEP 1986 or ASTM D-422 Mod | EPA 8270 | EPA 8270 SIM low level | EPA 8041 | NWTPH-Dx with acid/ silica gel cleanup | PSEP 1995[1] |
| Intertidal Sediment | SSI-SS-01 | 0-0.30 | Power Grab | -- | X | X | X | X | X | X | A | A |
| | SSI-SS-02 | 0-0.39 | Hand-collected | X | X | X | X | X | X | X | X | A |
| | SSI-SS-03 | 0-0.39 | Power Grab | -- | X | X | X | X | X | X | X | X |
| | SSI-SS-04 | 0-0.39 | Hand-collected | -- | X | X | X | X | X | X | X | A |
| | SSI-SS-05 | 0-0.39 | Power Grab | -- | X | X | X | X | X | X | X | X |
| | SSI-SS-06 | 0-0.39 | | -- | X | X | X | X | X | X | A | X |
| | SSI-SS-07 | 0-0.39 | | -- | X | X | X | X | X | X | A | A |
| | SSI-SC-01 | 0-2 | Vibracore | X | X | X | X | -- | X | X[2] | A | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | A | |
| | | 4-6 | | A | A | A | A | -- | A | A | A | |
| | SSI-SC-03 | 0-2 | | X | X | X | X | -- | X | X[2] | X | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | X | |
| | | 4-6 | | A | A | A | A | -- | A | A | A | |
| | | 6-8 | | A | A | A | A | -- | A | A | A | |
| | SSI-SC-04 | 0-2 | | X | X | X | X | -- | X | X[2] | X | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | X | |
| | SSI-SC-05 | 0-2 | | X | X | X | X | -- | X | X[2] | X | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | X | |
| | | 4-6 | | X | X | X | X | -- | X | A | X | |
| | | 6-8 | | A | A | A | A | -- | A | A | A | |
| | SSI-SC-06 | 0-2 | | X | X | X | X | -- | X | X[2] | A | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | A | |
| | | 4-6 | | X | X | X | X | -- | X | X[2] | A | |
| | | 6-7 | | A | A | A | A | -- | A | A | A | |
| | SSI-SC-07 | 0-2 | | X | X | X | X | -- | X | X[2] | A | |
| | | 2-4 | | X | X | X | X | -- | X | X[2] | A | |
| | | 4-6 | | X | X | X | X | -- | X | A | A | |
| | | 6-8 | | A | A | A | A | -- | A | A | A | |
| | PSB-SC-01 | 0-1 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-01 | 1-2 | Hand-collected | A | A | A | A | -- | A | A | -- | |
| | PSB-SC-02 | 0-1 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-02 | 1-2 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-03 | 0-1 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-03 | 1-2 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-04 | 0-1 | Hand-collected | X[3] | X[3] | X[3] | X[3] | -- | X | X[2] | -- | |
| | PSB-SC-04 | 1-2 | Hand-collected | A | A | A | A | -- | A | A | -- | |
| | COB-CC-C1 | 0-1 | Hand-collected | X | X | X | X | -- | -- | -- | -- | |
| | COB-CC-C2 | 0-1 | Hand-collected | X | X | X | X | -- | -- | -- | -- | |
| Subtidal Sediment | SSI-SS-08 | 0-0.39 | Power Grab | X | X | X | X | -- | A | -- | -- | |
| | SSI-SS-09 | 0-0.39 | | X | X | X | X | -- | X | X[2] | -- | |
| | SSI-SS-10 | 0-0.39 | | X | X | X | X | -- | X | -- | -- | |
| | SS-SSI-11 | 0-0.39 | | X | X | X | X | -- | X | -- | -- | |
| | SSI-SS-12 | 0-0.39 | | X | X | X | X | -- | X | -- | -- | |
| | SSI-SS-13 | 0-0.39 | | A | A | A | A | -- | A | -- | -- | |
| | SSI-SS-14 | 0-0.39 | | X | X | X | X | -- | A | -- | -- | |
| | SSI-SS-15 | 0-0.39 | | X | X | X | X | -- | A | -- | -- | |
| | SSI-SS-16 | 0-0.39 | | X | X | X | X | -- | A | -- | -- | |
| | SSI-SS-17 | 0-0.39 | | A | A | A | A | -- | A | -- | -- | |
| | SSI-SS-18 | 0-0.39 | | A | A | A | A | -- | A | -- | -- | |
| | CL-SG-1 | 0-0.33 | | X | -- | -- | -- | -- | -- | -- | -- | |
| | CL-SG-3 | 0-0.33 | | X | -- | -- | -- | -- | -- | -- | -- | |
| | CL-SG-4 | 0-0.33 | | X | -- | -- | -- | -- | -- | -- | -- | |

Notes:

[1]Benthic PAH toxicity evaluated with exposure to ultraviolet (UV) light according to the SCUM II 2015 Appendix C.

[2]Pentachlorophenol analysis only.

[3]Confirmation analysis to address the effect of compositing on previously collected intertidal sediment samples from 2013.

A = archive

cPAH = carcinogenic polycyclic aromatic hydrocarbons

EPA = Environmental Protection Agency

ft = feet

PAH = polycyclic aromatic hydrocarbons

PSEP = Puget Sound Estuary Program

SMS = Sediment Management Standards

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

X = chemical or chemical group was analyzed

-- = not analyzed for this group

# Table 3

## 2013-2016 Sediment Analytical Results Compared to Screening Levels for Protection of Benthic Organisms

R.G Haley Site
Bellingham, Washington

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Location** | | | | **PSB-01** | **PSB-02** | **PSB-02** | **PSB-03** | **PSB-03** | **PSB-04** | **SSI-SS-01** | **SSI-SC-01** | **SSI-SC-01** | **SSI-SS-02** |
| **Sample ID:** | | | | **PSB-SC-01-0-1** | **PSB-SC-02-0-1** | **PSB-SC-02-1-2** | **PSB-SC-03-0-1** | **PSB-SC-03-1-2** | **PSB-SC-04-0-1** | **SSI-SS-01_0-0.39** | **SSI-SC-01_0-2** | **SSI-SC-01_2-4** | **SSI-SS-02_0-0.39** |
| **Date Sampled:** | | | | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **10/15/2015** | **10/14/2015** | **10/14/2015** | **10/15/2015** |
| **Depth Interval (ft bml):** | | | | **0-1 ft** | **0-1 ft** | **1-2 ft** | **0-1 ft** | **1-2 ft** | **0-1 ft** | **0-0.39 ft** | **0-2 ft** | **2-4 ft** | **0-0.39 ft** |
| **Elevation at Top of Sample (ft NADV88):** | | | | **4.3** | **1.3** | **0.3** | **6.1** | **5.1** | **4.7** | **-5.2** | **-5.9** | **-7.9** | **-0.5** |
| **Collected By** | | | | **GeoEngineers** | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| Total Organic Carbon | Percent | 0.5 | 3.5 | **0.243** | **0.587** | **0.279** | **0.195** | **0.491** | **0.742** | **1.06** | **1.00** | **0.824 J** | **0.398** |
| Total Solids | Percent | NE | NE | **82.61** | **83.26** | **81.34** | **95.16** | **94.74** | **92.41** | **70.67** | **72.72** | **72.57** | **84.94** |
| **LPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of LPAHs | mg/kg OC | 370 | 780 | -- | -- | -- | -- | -- | -- | **54** | **84** | **95** | 3.5 |
| 2-Methylnaphthalene | mg/kg OC | 38 | 64 | -- | -- | -- | -- | -- | -- | **4.5** | **16** | **9.3** | 4.8 U |
| Acenaphthene | mg/kg OC | 16 | 57 | -- | -- | -- | -- | -- | -- | **3.6** | **4.2** | **4.0** | 4.8 U |
| Acenaphthylene | mg/kg OC | 66 | 66 | -- | -- | -- | -- | -- | -- | **3.6** | **5.0** | **4.4** | 4.8 U |
| Anthracene | mg/kg OC | 220 | 1,200 | -- | -- | -- | -- | -- | -- | **6.4** | **12** | **13** | 4.8 U |
| Fluorene | mg/kg OC | 23 | 79 | -- | -- | -- | -- | -- | -- | **4.2** | **6.8** | **7.8** | 4.8 U |
| Naphthalene | mg/kg OC | 99 | 170 | -- | -- | -- | -- | -- | -- | **8** | **22** | **32** | 4.8 U |
| Phenanthrene | mg/kg OC | 100 | 480 | -- | -- | -- | -- | -- | -- | **30** | **34** | **34** | 3.5 |
| **LPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of LPAHs | µg/kg | 5,200 | 5,200 | -- | -- | -- | -- | -- | -- | 570 | 840 | 780 | **14 J** |
| 2-Methylnaphthalene | µg/kg | 670 | 670 | -- | -- | -- | -- | -- | -- | 48 | 160 J | 77 | 19 U |
| Acenaphthene | µg/kg | 500 | 500 | -- | -- | -- | -- | -- | -- | 38 | 42 | 33 | 19 U |
| Acenaphthylene | µg/kg | 1,300 | 1,300 | -- | -- | -- | -- | -- | -- | 38 | 50 J | 36 | 19 U |
| Anthracene | µg/kg | 960 | 960 | -- | -- | -- | -- | -- | -- | 68 | 120 | 110 | 19 U |
| Fluorene | µg/kg | 540 | 540 | -- | -- | -- | -- | -- | -- | 45 | 68 | 64 | 19 U |
| Naphthalene | µg/kg | 2,100 | 2,100 | -- | -- | -- | -- | -- | -- | 80 | 220 | 260 | 19 U |
| Phenanthrene | µg/kg | 1,500 | 1,500 | -- | -- | -- | -- | -- | -- | 300 | 340 | 280 | **14 J** |
| **HPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of HPAHs | mg/kg OC | 960 | 5,300 | -- | -- | -- | -- | -- | -- | **120** | **210** | **220** | 29.6 |
| Benzo(a)anthracene | mg/kg OC | 110 | 270 | 3.2 | 1.7 | 9.3 | 3.4 | 0.8 J | 1.1 | **10** | **16** | **18** | 2.8 |
| Benzo(a)pyrene | mg/kg OC | 99 | 210 | 3.5 | 1.5 | 10.0 | 2.9 | 0.5 J | 1.0 | **14** | **22** | **22** | 3.5 |
| Benzofluoranthenes (Total) | mg/kg OC | 230 | 450 | 5.8 | 3.6 | 19.0 | 6.2 | 1.7 | 2.0 | **22** | **34** | **40** | 7 |
| Benzo(g,h,i)perylene | mg/kg OC | 31 | 78 | -- | -- | -- | -- | -- | -- | **8.2** | **13** | **10** | 3 |
| Chrysene | mg/kg OC | 110 | 460 | 3.8 | 3.1 | 14.0 | 4.4 | 1.1 | 1.6 | **13** | **20** | **21** | 4.3 |
| Dibenzo(a,h)anthracene | mg/kg OC | 12 | 33 | 1.9 U | 0.8 J | 2.0 | 2.5 U | 1.0 U | 0.6 U | **2.4** | **3.2** | **2.7** | 1.3 |
| Fluoranthene | mg/kg OC | 160 | 1,200 | -- | -- | -- | -- | -- | -- | **21** | **41** | **45** | 4 |
| Indeno(1,2,3-c,d)pyrene | mg/kg OC | 34 | 88 | 2.3 | 1.2 | 5.4 | 2.5 | 0.7 | 0.8 | **7** | **11** | **10** | 4.8 U |
| Pyrene | mg/kg OC | 1,000 | 1,400 | -- | -- | -- | -- | -- | -- | **25** | **53** | **55** | 4.3 |

| Sample Location | | | | PSB-01 | PSB-02 | PSB-02 | PSB-03 | PSB-03 | PSB-04 | SSI-SS-01 | SSI-SC-01 | SSI-SC-01 | SSI-SS-02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | | PSB-SC-01-0-1 | PSB-SC-02-0-1 | PSB-SC-02-1-2 | PSB-SC-03-0-1 | PSB-SC-03-1-2 | PSB-SC-04-0-1 | SSI-SS-01_0-0.39 | SSI-SC-01_0-2 | SSI-SC-01_2-4 | SSI-SS-02_0-0.39 |
| Date Sampled: | | | | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 10/15/2015 | 10/14/2015 | 10/14/2015 | 10/15/2015 |
| Depth Interval (ft bml): | | | | 0-1 ft | 0-1 ft | 1-2 ft | 0-1 ft | 1-2 ft | 0-1 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft |
| Elevation at Top of Sample (ft NADV88): | | | | 4.3 | 1.3 | 0.3 | 6.1 | 5.1 | 4.7 | -5.2 | -5.9 | -7.9 | -0.5 |
| Collected By | | | | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **HPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of HPAHs | µg/kg | 12,000 | 17,000 | – | – | – | – | – | – | 1,300 | 2,100 | 1,800 | **120** |
| Benzo(a)anthracene | µg/kg | 1,300 | 1,600 | **7.7** | 9.8 | **26** | **6.6** | **3.8 J** | 7.9 | 110 J | 160 | 150 | **11 J** |
| Benzo(a)pyrene | µg/kg | 1,600 | 1,600 | **8.5** | 9 | **28** | **5.6** | **2.6 J** | 7.3 | 150 | 220 | 180 | **14 J** |
| Benzofluoranthenes (Total) | µg/kg | 3,200 | 3,600 | **14** | 21 | **53** | **12** | **8.4** | 15 | 230 J | 340 | 300 | **28 J** |
| Benzo(g,h,i)perylene | µg/kg | 670 | 720 | – | – | – | – | – | – | 87 | 130 | 100 | **10 J** |
| Chrysene | µg/kg | 1,400 | 2,800 | **9.2** | 18 | **39** | **8.6** | **5.6** | 12 | 140 | 200 | 170 | **17 J** |
| Dibenzo(a,h)anthracene | µg/kg | 230 | 230 | 4.7 U | 4.5 J | **5.5** | 4.8 U | 4.9 U | 4.8 U | 25 | 32 | 22 | **5.3** |
| Fluoranthene | µg/kg | 1,700 | 2,500 | – | – | – | – | – | – | 220 J | 410 | 370 | **16 J** |
| Indeno(1,2,3-c,d)pyrene | µg/kg | 600 | 690 | **5.6** | 7.1 | **15** | **4.9** | **3.3** | 5.8 | 74 J | 110 | 83 | 19 U |
| Pyrene | µg/kg | 2,600 | 3,300 | – | – | – | – | – | – | 260 J | 530 | 450 | **17 J** |
| **Petroleum Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| Diesel Fuel | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | **16** |
| Motor Oil | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | **140** |
| Petroleum Hydrocarbons (Total) | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | **156** |
| **Chlorinated Hydrocarbons (OC-Normalized)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | mg/kg OC | 0.81 | 1.8 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | mg/kg OC | 2.3 | 2.3 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | mg/kg OC | NE | NE | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | mg/kg OC | 3.1 | 9 | – | – | – | – | – | – | **3** | – | – | 4.8 U |
| Hexachlorobenzene | mg/kg OC | 0.38 | 2.3 | – | – | – | – | – | – | 0.44 U | – | – | 1.2 U |
| **Chlorinated Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | µg/kg | 31 | 51 | – | – | – | – | – | – | 19 U | – | – | 19 U |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | µg/kg | 35 | 50 | – | – | – | – | – | – | 19 U | – | – | 19 U |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | µg/kg | NE | NE | – | – | – | – | – | – | 19 U | – | – | 19 U |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | µg/kg | 110 | 110 | – | – | – | – | – | – | 30 | – | – | 19 U |
| Hexachlorobenzene | µg/kg | 22 | 70 | – | – | – | – | – | – | 4.7 U | – | – | 4.7 U |
| **Phthalates (OC-Normalized)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | mg/kg OC | 47 | 78 | – | – | – | – | – | – | **13** | – | – | 12 U |
| Butyl benzyl Phthalate | mg/kg OC | 4.9 | 64 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| Dibutyl Phthalate | mg/kg OC | 220 | 1,700 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| Diethyl Phthalate | mg/kg OC | 61 | 110 | – | – | – | – | – | – | **3.1** | – | – | 30 |
| Dimethyl Phthalate | mg/kg OC | 53 | 53 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| Di-n-Octyl Phthalate | mg/kg OC | 58 | 4,500 | – | – | – | – | – | – | 1.8 U | – | – | 4.8 U |
| **Phthalates (Dry Weight)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | µg/kg | 1,300 | 1,900 | – | – | – | – | – | – | 140 | – | – | 47 U |
| Butyl Benzyl Phthalate | µg/kg | 63 | 900 | – | – | – | – | – | – | 19 U | – | – | 19 U |
| Dibutyl Phthalate | µg/kg | 1,400 | 1,400 | – | – | – | – | – | – | 19 U | – | – | 19 U |
| Diethyl Phthalate | µg/kg | 200 | 200 | – | – | – | – | – | – | 33 U | – | – | 100 U |
| Dimethyl Phthalate | µg/kg | 71 | 160 | – | – | – | – | – | – | 19 U | – | – | 19 U |
| Di-n-Octyl Phthalate | µg/kg | 6,200 | 6,200 | – | – | – | – | – | – | 19 U | – | – | 19 U |

| | | | Sample Location | PSB-01 | PSB-02 | PSB-02 | PSB-03 | PSB-03 | PSB-04 | SSI-SS-01 | SSI-SC-01 | SSI-SC-01 | SSI-SS-02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Sample ID:** | **PSB-SC-01-0-1** | **PSB-SC-02-0-1** | **PSB-SC-02-1-2** | **PSB-SC-03-0-1** | **PSB-SC-03-1-2** | **PSB-SC-04-0-1** | **SSI-SS-01_0-0.39** | **SSI-SC-01_0-2** | **SSI-SC-01_2-4** | **SSI-SS-02_0-0.39** |
| | | | **Date Sampled:** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **2/18/2016** | **10/15/2015** | **10/14/2015** | **10/14/2015** | **10/15/2015** |
| | | | **Depth Interval (ft bml):** | **0-1 ft** | **0-1 ft** | **1-2 ft** | **0-1 ft** | **1-2 ft** | **0-1 ft** | **0-0.39 ft** | **0-2 ft** | **2-4 ft** | **0-0.39 ft** |
| | | | **Elevation at Top of Sample (ft NADV88):** | **4.3** | **1.3** | **0.3** | **6.1** | **5.1** | **4.7** | **-5.2** | **-5.9** | **-7.9** | **-0.5** |
| | | | **Collected By** | **GeoEngineers** | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **Phenols (Dry Weight)** | | | | | | | | | | | | | |
| 2,4-Dimethylphenol | µg/kg | 29 | 29 | -- | -- | -- | -- | -- | -- | 24 U | -- | -- | 23 U |
| 2-Methylphenol (o-Cresol) | µg/kg | 63 | 63 | -- | -- | -- | -- | -- | -- | 19 U | -- | -- | 19 U |
| 4-Methylphenol (p-Cresol) | µg/kg | 670 | 670 | -- | -- | -- | -- | -- | -- | **64** | -- | -- | 19 U |
| Pentachlorophenol | µg/kg | 360 | 690 | **18** | **12** | **26 NJ** | **19 NJ** | **20** | **33** | 94 U | **52** | **160 NJ** | 93 U |
| Phenol | µg/kg | 420 | 1,200 | -- | -- | -- | -- | -- | -- | **280 J** | -- | -- | 19 U |
| **Miscellaneous Extractables (OC-Normalized)** | | | | | | | | | | | | | |
| Dibenzofuran | mg/kg OC | 15 | 58 | -- | -- | -- | -- | -- | -- | **4** | -- | -- | 4.8 U |
| Hexachlorobutadiene | mg/kg OC | 3.9 | 6.2 | -- | -- | -- | -- | -- | -- | 0.44 U | -- | -- | 1.2 U |
| n-Nitrosodiphenylamine (as diphenylamine) | mg/kg OC | 11 | 11 | -- | -- | -- | -- | -- | -- | 1.8 U | -- | -- | 4.8 U |
| **Miscellaneous Extractables (Dry Weight)** | | | | | | | | | | | | | |
| Dibenzofuran | µg/kg | 540 | 540 | -- | -- | -- | -- | -- | -- | **42** | -- | -- | 19 U |
| Hexachlorobutadiene | µg/kg | 11 | 120 | -- | -- | -- | -- | -- | -- | 4.7 U | -- | -- | 4.7 U |
| n-Nitrosodiphenylamine (as diphenylamine) | µg/kg | 28 | 40 | -- | -- | -- | -- | -- | -- | 19 U | -- | -- | 19 U |
| Benzoic Acid | µg/kg | 650 | 650 | -- | -- | -- | -- | -- | -- | 190 U | -- | -- | 190 U |
| Benzyl Alcohol | µg/kg | 57 | 730 | -- | -- | -- | -- | -- | -- | 19 UJ | -- | -- | 19 UJ |
| **Conventionals** | | | | | | | | | | | | | |
| Gravel | Percent | NE | NE | **34.0** | **42.8** | **43.8** | **51.5** | **50.9** | **60.5** | **26.0** | **14.0** | **16.7** | **63.2** |
| Very coarse sand | Percent | NE | NE | **13.5** | **11.8** | **11.4** | **8.1** | **9.2** | **11.1** | **4.1** | **6.1** | **6.3** | **12.8** |
| Coarse sand | Percent | NE | NE | **26.5** | **20.0** | **19.5** | **15.3** | **15.9** | **13.2** | **6.5** | **8.6** | **8.4** | **14.1** |
| Medium sand | Percent | NE | NE | **22.3** | **20.5** | **18.8** | **20.9** | **19.8** | **11.1** | **26.3** | **26.6** | **22.6** | **8.3** |
| Fine sand | Percent | NE | NE | **2.2** | **2.9** | **3.1** | **3.4** | **3.4** | **3.1** | **22.4** | **25.8** | **23.0** | **1.0** |
| Very fine sand | Percent | NE | NE | **0.4** | **0.2** | **0.3** | **0.1** | **0.2** | **0.2** | **4.5** | **8.5** | **8.2** | **0.2** |
| Coarse silt | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **4.7** | **0.9** | **2.6** | 0.4 U |
| Medium silt | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **0.8** | **1.6** | **1.6** | 0.4 U |
| Fine silt | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **1.2** | **2.6** | **2.5** | 0.4 U |
| Very fine silt | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **0.7** | **1.3** | **1.8** | 0.4 U |
| Coarse clay | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **0.7** | **0.9** | **1.6** | 0.4 U |
| Medium clay | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **0.7** | **1.2** | **1.7** | 0.4 U |
| Particle/Grain size, Phi Scale >10 | Percent | NE | NE | 1.0 U | 1.9 U | 3.1 U | 0.6 U | 0.5 U | 1.0 U | **1.3** | **2.1** | **3.0** | 0.4 U |
| Total Fines | Percent | NE | NE | **1.0** | **1.9** | **3.1** | **0.6** | **0.5** | **1.0** | **10.2** | **10.5** | **14.8** | **0.4** |

| | | | Sample Location | SSI-SS-03 | SSI-SC-03 | SSI-SC-03 | SSI-SS-04 | SSI-SC-04 | SSI-SC-04 | SSI-SS-05 | SSI-SC-05 | SSI-SC-05 | SSI-SC-05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID: | SSI-SS-03_0-0.39 | SSI-SC-03_0-2 | SSI-SC-03_2-4 | SSI-SS-04-0_0.39 | SSI-SC-04_0-2 | SSI-SC-04_2-4 | SSI-SS-05_0-0.39 | SSI-SC-05_0-2 | SSI-SC-05_2-4 | SSI-SC-05_4-6 |
| | | | Date Sampled: | 10/15/2015 | 10/14/2015 | 10/14/2015 | 10/15/2015 | 10/15/2015 | 10/15/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 |
| | | | Depth Interval (ft bml): | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft |
| | | | Elevation at Top of Sample (ft NADV88): | -8.3 | -3.1 | -5.1 | -0.5 | 0.4 | -1.6 | -4.9 | -3.5 | -5.5 | -7.5 |
| | | | Collected By | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| Total Organic Carbon | Percent | 0.5 | 3.5 | **2.98** | **1.27** | **2.96** | **0.111** | **1.38** | **2.76** | **1.05** | **17.9** | **8.71** | **2.17** |
| Total Solids | Percent | NE | NE | **55.42** | **61.34** | **51.27** | **79.30** | **84.28** | **78.75** | **66.29** | **58.74** | **48.74** | **49.37** |
| **LPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of LPAHs | mg/kg OC | 370 | 780 | **110** | **190** | **26** | 13 | **170** | **220** | **240** | 73 | 170 | **16** |
| 2-Methylnaphthalene | mg/kg OC | 38 | 64 | **10** | **14** | **2** | 17 U | **6.2** | **12** | **54** | 3.5 | 6.4 | **1.6** |
| Acenaphthene | mg/kg OC | 16 | 57 | **3.7** | **9.4** | **1.2** | 17 U | **19** | **28** | **10** | 4.0 | 4.2 | **0.74** |
| Acenaphthylene | mg/kg OC | 66 | 66 | **6** | **9.4** | **1.5** | 17 U | **4.1** | **5.4** | **10** | 2 | 6.3 | **0.69** |
| Anthracene | mg/kg OC | 220 | 1,200 | **10** | **14** | **2.4** | 17 U | **20** | **24** | **20** | 6.7 | 10 | **1.3** |
| Fluorene | mg/kg OC | 23 | 79 | **4.7** | **17** | **2.2** | 17 U | **20** | **25** | **13** | 6.1 | 11 | **1.2** |
| Naphthalene | mg/kg OC | 99 | 170 | **37** | **87** | **11** | 5 | **55** | **69** | **110** | 30 | 86 | **6.5** |
| Phenanthrene | mg/kg OC | 100 | 480 | **50** | **56** | **7.8** | 7.7 | **54** | **69** | **74** | 26 | 54 | **5.5** |
| **LPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of LPAHs | µg/kg | 5,200 | 5,200 | 3,400 | 2,400 | 770 | **14 J** | 2,400 | 6,100 | 2,500 | **13,000** | **15,000** | 350 |
| 2-Methylnaphthalene | µg/kg | 670 | 670 | 300 | 180 | 59 | 19 U | 86 | 340 | 570 | **620** | **560** | 35 |
| Acenaphthene | µg/kg | 500 | 500 | 110 | 120 | 36 | 19 U | 260 | 780 | 110 | **800** | **370** | 16 |
| Acenaphthylene | µg/kg | 1,300 | 1,300 | 180 | 120 | 43 | 19 U | 57 | 150 | 110 | **360** | **550** | 15 |
| Anthracene | µg/kg | 960 | 960 | 400 | 180 | 71 | 19 U | 270 | 670 | 200 | **1,200** | **1,000** | 29 |
| Fluorene | µg/kg | 540 | 540 | 140 | 210 | 65 | 19 U | 280 | 680 | 140 | **1,100** | **980** | 26 |
| Naphthalene | µg/kg | 2,100 | 2,100 | 1,100 | 1,100 | 320 | **5.6 J** | 760 | 1,900 | 1,200 | **5,000** | **7,500** | 140 |
| Phenanthrene | µg/kg | 1,500 | 1,500 | 1,500 | 710 | 230 | **8.5 J** | 740 | 1,900 | 780 | **4,700** | **4,700** | 120 |
| **HPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of HPAHs | mg/kg OC | 960 | 5,300 | **300** | **190** | **30** | 40 | **180** | **220** | **320** | 82.5 | 115.5 | **16** |
| Benzo(a)anthracene | mg/kg OC | 110 | 270 | **29** | **13** | **2.5** | 17 U | **12** | **16** | **24** | 5.1 | 5.5 | **1** |
| Benzo(a)pyrene | mg/kg OC | 99 | 210 | **28** | **13** | **2.6** | 17 U | **9.4** | **13** | **23** | 4.1 | 6.0 | **1.2** |
| Benzofluoranthenes (Total) | mg/kg OC | 230 | 450 | **50** | **18** | **4.1** | 11 | **15** | **20** | **45** | 7.3 | 9.3 | **1.7** |
| Benzo(g,h,i)perylene | mg/kg OC | 31 | 78 | **13** | **8.7** | **2.2** | 17 U | **7** | **7** | **17** | 2.3 | 4.2 | **1.1** |
| Chrysene | mg/kg OC | 110 | 460 | **37** | **20** | **2.5** | 6.8 | **16** | **18** | **34** | 6.1 | 6.4 | **1.3** |
| Dibenzo(a,h)anthracene | mg/kg OC | 12 | 33 | **4** | **1.4** | **0.44** | 2.6 | **1** | **1.6** | **3.6** | 0.61 | 0.62 | **0.29** |
| Fluoranthene | mg/kg OC | 160 | 1,200 | **64** | **53** | **8.4** | 9 | **60** | **70** | **77** | 29 | 41 | **4.5** |
| Indeno(1,2,3-c,d)pyrene | mg/kg OC | 34 | 88 | **10** | **5.9** | **1.5** | 17 U | **5.3** | **6.5** | **14** | 2.1 | 3.3 | **1** |
| Pyrene | mg/kg OC | 1,000 | 1,400 | **60** | **60** | **9.1** | 11 | **53** | **65** | **82** | 26 | 39 | **3.6** |

| | | | Sample Location | SSI-SS-03 | SSI-SC-03 | SSI-SC-03 | SSI-SS-04 | SSI-SC-04 | SSI-SC-04 | SSI-SS-05 | SSI-SC-05 | SSI-SC-05 | SSI-SC-05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Sample ID:** | SSI-SS-03_0-0.39 | SSI-SC-03_0-2 | SSI-SC-03_2-4 | SSI-SS-04-0_0.39 | SSI-SC-04_0-2 | SSI-SC-04_2-4 | SSI-SS-05_0-0.39 | SSI-SC-05_0-2 | SSI-SC-05_2-4 | SSI-SC-05_4-6 |
| | | | **Date Sampled:** | 10/15/2015 | 10/14/2015 | 10/14/2015 | 10/15/2015 | 10/15/2015 | 10/15/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 |
| | | | **Depth Interval (ft bml):** | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft |
| | | | **Elevation at Top of Sample (ft NADV88):** | -8.3 | -3.1 | -5.1 | -0.5 | 0.4 | -1.6 | -4.9 | -3.5 | -5.5 | -7.5 |
| | | | **Collected By** | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **HPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of HPAHs | µg/kg | 12,000 | 17,000 | 8,900 | 2,400 | 990 | **44** | 2,400 | 6,100 | 3,400 | **15,000** | **10,000** | 340 |
| Benzo(a)anthracene | µg/kg | 1,300 | 1,600 | 870 | 160 | 75 | 19 U | 160 | 440 | 250 | **920** | **480** | 22 |
| Benzo(a)pyrene | µg/kg | 1,600 | 1,600 | 840 | 160 | 77 | 19 U | 130 | 360 | 240 | **740** | **500** | 25 |
| Benzofluoranthenes (Total) | µg/kg | 3,200 | 3,600 | 1,500 | 230 | 120 | **12 J** | 210 | 560 | 470 | **1,300** | **810** | 36 |
| Benzo(g,h,i)perylene | µg/kg | 670 | 720 | 380 | 110 | 64 | 19 U | 96 | 200 | 180 | **420** | **370** | 23 |
| Chrysene | µg/kg | 1,400 | 2,800 | 1,100 | 200 | 74 | **7.5 J** | 220 | 510 | 360 | **1,100** | **560** | 28 |
| Dibenzo(a,h)anthracene | µg/kg | 230 | 230 | 120 | 18 | 13 J | **2.9 J** | 20 | 45 | 38 | **110** | **54** | 6.3 |
| Fluoranthene | µg/kg | 1,700 | 2,500 | 1,900 | 670 | 250 | **10 J** | 800 | 2,000 | 810 | **5,200** | **3,600** | 98 |
| Indeno(1,2,3-c,d)pyrene | µg/kg | 600 | 690 | 400 | 75 | 45 | 19 U | 73 | 180 | 150 | **380** | **290** | 22 |
| Pyrene | µg/kg | 2,600 | 3,300 | 1,800 | 760 | 270 | **12 J** | 730 | 1,800 | 860 | **4,600** | **3,400** | 79 |
| **Petroleum Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| Diesel Fuel | mg/kg | 260 | 260 | **220** | **230** | **84** | 6.1 U | **44 J** | **92** | **58** | **310** | **230** | **15** |
| Motor Oil | mg/kg | 260 | 260 | **430** | **370** | **140** | 12 U | **68** | **140** | **120** | **550** | **340** | **24** |
| Petroleum Hydrocarbons (Total) | mg/kg | 260 | 260 | **650** | **600** | **224** | 12 U | **112** | **232** | **178** | **860** | **570** | **39** |
| **Chlorinated Hydrocarbons (OC-Normalized)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | mg/kg OC | 0.81 | 1.8 | 0.64 U | – | – | 17 U | – | – | 1.8 U | – | – | – |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | mg/kg OC | 2.3 | 2.3 | **0.44** | – | – | 17 U | – | – | 1.8 U | – | – | – |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | mg/kg OC | NE | NE | 0.64 U | – | – | 17 U | – | – | 1.8 U | – | – | – |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | mg/kg OC | 3.1 | 9 | **3** | – | – | 17 U | – | – | **3.5** | – | – | – |
| Hexachlorobenzene | mg/kg OC | 0.38 | 2.3 | 0.16 U | – | – | 4.2 U | – | – | 0.46 U | – | – | – |
| **Chlorinated Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | µg/kg | 31 | 51 | 19 U | – | – | 19 U | – | – | 19 U | – | – | – |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | µg/kg | 35 | 50 | 13 J | – | – | 19 U | – | – | 19 U | – | – | – |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | µg/kg | NE | NE | 19 U | – | – | 19 U | – | – | 19 U | – | – | – |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | µg/kg | 110 | 110 | 100 | – | – | 19 U | – | – | 37 | – | – | – |
| Hexachlorobenzene | µg/kg | 22 | 70 | 4.8 U | – | – | 4.7 U | – | – | 4.8 U | – | – | – |
| **Phthalates (OC-Normalized)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | mg/kg OC | 47 | 78 | **4.4** | – | – | 42 U | – | – | **14** | – | – | – |
| Butyl benzyl Phthalate | mg/kg OC | 4.9 | 64 | **2.4** | – | – | 17 U | – | – | 1.8 U | – | – | – |
| Dibutyl Phthalate | mg/kg OC | 220 | 1,700 | 0.64 U | – | – | 17 U | – | – | **1.1** | – | – | – |
| Diethyl Phthalate | mg/kg OC | 61 | 110 | **3** | – | – | 23 | – | – | **4.1** | – | – | – |
| Dimethyl Phthalate | mg/kg OC | 53 | 53 | 0.64 U | – | – | 17 U | – | – | **7** | – | – | – |
| Di-n-Octyl Phthalate | mg/kg OC | 58 | 4,500 | **0.6** | – | – | 17 U | – | – | 1.8 U | – | – | – |
| **Phthalates (Dry Weight)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | µg/kg | 1,300 | 1,900 | 130 | – | – | 47 U | – | – | 150 | – | – | – |
| Butyl Benzyl Phthalate | µg/kg | 63 | 900 | 73 | – | – | 19 U | – | – | 19 U | – | – | – |
| Dibutyl Phthalate | µg/kg | 1,400 | 1,400 | 19 U | – | – | 19 U | – | – | 12 J | – | – | – |
| Diethyl Phthalate | µg/kg | 200 | 200 | 100 U | – | – | 25 U | – | – | 43 U | – | – | – |
| Dimethyl Phthalate | µg/kg | 71 | 160 | 19 U | – | – | 19 U | – | – | 70 | – | – | – |
| Di-n-Octyl Phthalate | µg/kg | 6,200 | 6,200 | 18 J | – | – | 19 U | – | – | 19 U | – | – | – |

| Sample Location | | | | SSI-SS-03 | SSI-SC-03 | SSI-SC-03 | SSI-SS-04 | SSI-SC-04 | SSI-SC-04 | SSI-SS-05 | SSI-SC-05 | SSI-SC-05 | SSI-SC-05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | | SSI-SS-03_0-0.39 | SSI-SC-03_0-2 | SSI-SC-03_2-4 | SSI-SS-04-0_0.39 | SSI-SC-04_0-2 | SSI-SC-04_2-4 | SSI-SS-05_0-0.39 | SSI-SC-05_0-2 | SSI-SC-05_2-4 | SSI-SC-05_4-6 |
| Date Sampled: | | | | 10/15/2015 | 10/14/2015 | 10/14/2015 | 10/15/2015 | 10/15/2015 | 10/15/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 |
| Depth Interval (ft bml): | | | | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft |
| Elevation at Top of Sample (ft NADV88): | | | | -8.3 | -3.1 | -5.1 | -0.5 | 0.4 | -1.6 | -4.9 | -3.5 | -5.5 | -7.5 |
| Collected By | | | | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **Phenols (Dry Weight)** | | | | | | | | | | | | | |
| 2,4-Dimethylphenol | µg/kg | 29 | 29 | **47** | – | – | 24 U | – | – | **19 J** | – | – | – |
| 2-Methylphenol (o-Cresol) | µg/kg | 63 | 63 | **47** | – | – | 19 U | – | – | **26** | – | – | – |
| 4-Methylphenol (p-Cresol) | µg/kg | 670 | 670 | **430** | – | – | 19 U | – | – | **270** | – | – | – |
| Pentachlorophenol | µg/kg | 360 | 690 | **170** | **150 NJ** | **46 NJ** | 94 U | **23 NJ** | **54** | **580** | **140** | **59 NJ** | – |
| Phenol | µg/kg | 420 | 1,200 | **410 J** | – | – | 19 U | – | – | **120** | – | – | – |
| **Miscellaneous Extractables (OC-Normalized)** | | | | | | | | | | | | | |
| Dibenzofuran | mg/kg OC | 15 | 58 | **5.4** | – | – | 17 U | – | – | **14** | – | – | – |
| Hexachlorobutadiene | mg/kg OC | 3.9 | 6.2 | 0.16 U | – | – | 4.2 U | – | – | 0.46 U | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | mg/kg OC | 11 | 11 | 0.64 U | – | – | 17 U | – | – | 1.8 U | – | – | – |
| **Miscellaneous Extractables (Dry Weight)** | | | | | | | | | | | | | |
| Dibenzofuran | µg/kg | 540 | 540 | **160** | – | – | 19 U | – | – | **150** | – | – | – |
| Hexachlorobutadiene | µg/kg | 11 | 120 | 4.8 U | – | – | 4.7 U | – | – | 4.8 U | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | µg/kg | 28 | 40 | 19 U | – | – | 19 U | – | – | 19 U | – | – | – |
| Benzoic Acid | µg/kg | 650 | 650 | **500** | – | – | 190 U | – | – | **350** | – | – | – |
| Benzyl Alcohol | µg/kg | 57 | 730 | **50 J** | – | – | 19 UJ | – | – | **78 J** | – | – | – |
| **Conventionals** | | | | | | | | | | | | | |
| Gravel | Percent | NE | NE | **3.4** | **11.7** | **9.9** | **17.4** | **25.1** | **39.9** | **4.6** | **7.0** | **3.9** | **0.5** |
| Very coarse sand | Percent | NE | NE | **5.7** | **7.1** | **7.2** | **5.5** | **7.3** | **5.8** | **4.1** | **5.9** | **6.4** | **0.9** |
| Coarse sand | Percent | NE | NE | **5.2** | **7.0** | **8.4** | **28.0** | **13.8** | **11.1** | **7.3** | **7.0** | **7.5** | **0.7** |
| Medium sand | Percent | NE | NE | **11.5** | **13.2** | **17.4** | **43.0** | **25.7** | **18.2** | **23.1** | **15.2** | **8.2** | **0.5** |
| Fine sand | Percent | NE | NE | **26.8** | **28.4** | **32.7** | **4.7** | **10.4** | **9.5** | **28.8** | **19.6** | **8.7** | **0.8** |
| Very fine sand | Percent | NE | NE | **21.8** | **18.1** | **16.5** | **0.5** | **3.8** | **5.8** | **13.2** | **11.2** | **9.0** | **5.0** |
| Coarse silt | Percent | NE | NE | **0.6** | **2.5** | **0.8** | 1.0 U | **6.2** | **1.9** | **5.0** | **9.8** | **6.8** | **20.0** |
| Medium silt | Percent | NE | NE | **3.1** | **1.8** | **1.0** | 1.0 U | **1.6** | **2.1** | **1.7** | **4.0** | **10.5** | **15.3** |
| Fine silt | Percent | NE | NE | **4.4** | **1.8** | **1.2** | 1.0 U | **1.5** | **1.8** | **3.0** | **3.6** | **8.6** | **12.7** |
| Very fine silt | Percent | NE | NE | **4.4** | **1.9** | **1.1** | 1.0 U | **1.2** | **1.6** | **2.1** | **4.0** | **8.1** | **10.9** |
| Coarse clay | Percent | NE | NE | **3.9** | **1.7** | **0.9** | 1.0 U | **1.0** | **0.8** | **1.6** | **3.1** | **5.1** | **7.7** |
| Medium clay | Percent | NE | NE | **2.5** | **1.5** | **0.9** | 1.0 U | **0.8** | **0.7** | **1.6** | **3.3** | **5.3** | **6.9** |
| Particle/Grain size, Phi Scale >10 | Percent | NE | NE | **6.7** | **3.2** | **1.9** | 1.0 U | **1.5** | **0.9** | **3.7** | **6.4** | **12.0** | **17.9** |
| Total Fines | Percent | NE | NE | **25.6** | **14.5** | **7.8** | **1.0** | **13.7** | **9.8** | **18.8** | **34.2** | **56.3** | **91.5** |

| Sample Location | | | | SSI-SS-06 | SSI-SC-06 | SSI-SC-06 | SSI-SC-06 | SSI-SS-07 | SSI-SC-07 | SSI-SC-07 | SSI-SC-07 | SSI-SS-08 | SSI-SS-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | | SSI-SS-06_0-0.39 | SSI-SC-06_0-2 | SSI-SC-06_2-4 | SSI-SC-06_4-6 | SSI-SS-07_0-0.39 | SSI-SC-07_0-2 | SSI-SC-07_2-4 | SSI-SC-07_4-6 | SSI-SS-08_0-0.39 | SSI-SS-09_0-0.39 |
| Date Sampled: | | | | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/12/2015 |
| Depth Interval (ft bml): | | | | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-0.39 ft |
| Elevation at Top of Sample (ft NADV88): | | | | -5.5 | -2.8 | -4.8 | -6.8 | -3.7 | -3.3 | -5.3 | -7.3 | -22.0 | -16.9 |
| Collected By | | | | GeoEngineers | | | | | | | | | |
| Parameter | Unit(s) | SCO/LAET[1] | CSL/2LAET[1] | | | | | | | | | | |
| Total Organic Carbon | Percent | 0.5 | 3.5 | 3.10 | 1.18 | 4.35 | 7.44 | 0.955 | 0.904 | 27.7 | 33.8 | 2.64 | 3.15 |
| Total Solids | Percent | NE | NE | 61.17 | 71.54 | 53.86 | 62.62 | 73.89 | 73.69 | 28.56 | 37.67 | 31.75 | 37.43 |
| **LPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of LPAHs | mg/kg OC | 370 | 780 | 200 | 200 | 320 | 90 | 27 | 58 | 83 | 56 | -- | -- |
| 2-Methylnaphthalene | mg/kg OC | 38 | 64 | 21 | 20 | 25 | 7.0 | 3.4 | 3.0 | 0.43 | 0.77 | -- | -- |
| Acenaphthene | mg/kg OC | 16 | 57 | 7.7 | 14 | 20 | 5.8 | 1.7 | 4.5 | 13 | 8.0 | -- | -- |
| Acenaphthylene | mg/kg OC | 66 | 66 | 8.1 | 7.8 | 10 | 4.3 | 1.3 | 2.4 | 0.27 | 0.28 | -- | -- |
| Anthracene | mg/kg OC | 220 | 1,200 | 12 | 20 | 20 | 5.6 | 2.4 | 8.0 | 10 | 9.0 | -- | -- |
| Fluorene | mg/kg OC | 23 | 79 | 8.4 | 19 | 30 | 7.9 | 2.3 | 6.5 | 22 | 10 | -- | -- |
| Naphthalene | mg/kg OC | 99 | 170 | 74 | 72 | 140 | 43 | 12 | 18 | 1.7 | 3.8 | -- | -- |
| Phenanthrene | mg/kg OC | 100 | 480 | 52 | 73 | 83 | 30 | 8 | 19 | 35 | 23 | -- | -- |
| **LPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of LPAHs | µg/kg | 5,200 | 5,200 | 5,000 | 2,400 | 14,000 | 6,700 | 260 J | 520 | 23,000 | 19,000 | -- | -- |
| 2-Methylnaphthalene | µg/kg | 670 | 670 | 640 | 200 | 1,100 | 500 | 32 | 27 | 120 | 260 | -- | -- |
| Acenaphthene | µg/kg | 500 | 500 | 240 | 170 | 1,000 | 430 | 16 J | 41 | 3,600 | 2,700 | -- | -- |
| Acenaphthylene | µg/kg | 1,300 | 1,300 | 250 | 92 | 600 | 320 | 12 J | 22 | 76 | 95 | -- | -- |
| Anthracene | µg/kg | 960 | 960 | 360 | 240 | 1,000 | 420 | 23 | 70 | 3,000 | 3,000 | -- | -- |
| Fluorene | µg/kg | 540 | 540 | 260 | 230 | 1,300 | 590 | 22 | 59 | 6,100 | 4,000 | -- | -- |
| Naphthalene | µg/kg | 2,100 | 2,100 | 2,300 | 850 | 6,300 | 3,200 | 110 | 160 | 470 | 1,300 | -- | -- |
| Phenanthrene | µg/kg | 1,500 | 1,500 | 1,600 | 860 | 3,600 | 2,000 | 76 | 170 | 9,600 | 7,900 | -- | -- |
| **HPAHs (OC-Normalized)** | | | | | | | | | | | | | |
| Sum of HPAHs | mg/kg OC | 960 | 5,300 | 170 | 270 | 260 | 72 | 43 | 116 | 51.1 | 60 | -- | -- |
| Benzo(a)anthracene | mg/kg OC | 110 | 270 | 12 | 19 | 16 | 4.2 | 3.2 | 7.6 | 4.3 | 4.1 | -- | 1.7 |
| Benzo(a)pyrene | mg/kg OC | 99 | 210 | 10 | 19 | 13 | 3.0 | 2.7 | 8.7 | 1.2 | 1.2 | -- | 1.4 |
| Benzofluoranthenes (Total) | mg/kg OC | 230 | 450 | 20 | 32 | 20 | 6.2 | 6.2 | 19 | 3.0 | 3.0 | -- | 3.1 |
| Benzo(g,h,i)perylene | mg/kg OC | 31 | 78 | 7.1 | 14 | 9.0 | 2.3 | 2 | 5.1 | 0.27 | 0.33 | -- | -- |
| Chrysene | mg/kg OC | 110 | 460 | 16 | 24 | 20 | 5.8 | 4.8 | 11 | 5.4 | 4.7 | -- | 2.4 |
| Dibenzo(a,h)anthracene | mg/kg OC | 12 | 33 | 1.5 | 2.8 | 1.7 | 0.35 | 0.42 | 1.3 | 0.17 | 0.12 | -- | 0.3 |
| Fluoranthene | mg/kg OC | 160 | 1,200 | 45 | 81 | 94 | 26 | 9 | 29 | 24 | 28 | -- | -- |
| Indeno(1,2,3-c,d)pyrene | mg/kg OC | 34 | 88 | 6.1 | 10 | 6.7 | 1.5 | 1.5 | 4 | 0.3 | 0.33 | -- | 0.92 |
| Pyrene | mg/kg OC | 1,000 | 1,400 | 48 | 72 | 76 | 23 | 13 | 30 | 13 | 18 | -- | -- |

| | | | Sample Location | SSI-SS-06 | SSI-SC-06 | SSI-SC-06 | SSI-SC-06 | SSI-SS-07 | SSI-SC-07 | SSI-SC-07 | SSI-SC-07 | SSI-SS-08 | SSI-SS-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID: | SSI-SS-06_0-0.39 | SSI-SC-06_0-2 | SSI-SC-06_2-4 | SSI-SC-06_4-6 | SSI-SS-07_0-0.39 | SSI-SC-07_0-2 | SSI-SC-07_2-4 | SSI-SC-07_4-6 | SSI-SS-08_0-0.39 | SSI-SS-09_0-0.39 |
| | | | Date Sampled: | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/12/2015 |
| | | | Depth Interval (ft bml): | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-0.39 ft |
| | | | Elevation at Top of Sample (ft NADV88): | -5.5 | -2.8 | -4.8 | -6.8 | -3.7 | -3.3 | -5.3 | -7.3 | -22.0 | -16.9 |
| | | | Collected By | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **HPAHs (Dry Weight)** | | | | | | | | | | | | | |
| Sum of HPAHs | µg/kg | 12,000 | 17,000 | 5,200 | 3,200 | **11,000** | **5,300** | 410 | 1,100 | **14,000** | **20,000** | – | – |
| Benzo(a)anthracene | µg/kg | 1,300 | 1,600 | 370 | 220 | **680** | **310** | 31 | 69 | **1,200** | **1,400** | – | 55 J |
| Benzo(a)pyrene | µg/kg | 1,600 | 1,600 | 320 | 230 | **550** | **220** | 26 | 79 | **320** | **390** | – | 44 J |
| Benzofluoranthenes (Total) | µg/kg | 3,200 | 3,600 | 610 | 380 | **1,000** | **460** | 59 | 170 | **820** | **1,000** | – | 98 J |
| Benzo(g,h,i)perylene | µg/kg | 670 | 720 | 220 | 160 | **400** | **170** | 19 | 46 | **74** | **110** | – | – |
| Chrysene | µg/kg | 1,400 | 2,800 | 490 | 280 | **900** | **430** | 46 | 99 | **1,500** | **1,600** | – | 76 J |
| Dibenzo(a,h)anthracene | µg/kg | 230 | 230 | 47 | 33 | **76** | **26** | 4.0 J | 12 J | **47** | **39** | – | 10 J |
| Fluoranthene | µg/kg | 1,700 | 2,500 | 1,400 | 950 | **4,100** | **1,900** | 90 | 260 | **6,600** | **9,400** | – | – |
| Indeno(1,2,3-c,d)pyrene | µg/kg | 600 | 690 | 190 | 120 | **290** | **110** | 14 J | 40 | **90** | **110** | – | 29 J |
| Pyrene | µg/kg | 2,600 | 3,300 | 1,500 | 850 | **3,300** | **1,700** | 120 | 270 | **3,500** | **6,100** | – | – |
| **Petroleum Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| Diesel Fuel | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | – |
| Motor Oil | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | – |
| Petroleum Hydrocarbons (Total) | mg/kg | 260 | 260 | – | – | – | – | – | – | – | – | – | – |
| **Chlorinated Hydrocarbons (OC-Normalized)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | mg/kg OC | 0.81 | 1.8 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | mg/kg OC | 2.3 | 2.3 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | mg/kg OC | NE | NE | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | mg/kg OC | 3.1 | 9 | **1.2** | – | – | – | 2 U | – | – | – | – | – |
| Hexachlorobenzene | mg/kg OC | 0.38 | 2.3 | **0.11** | – | – | – | 0.5 U | – | – | – | – | – |
| **Chlorinated Hydrocarbons (Dry Weight)** | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | µg/kg | 31 | 51 | 19 U | – | – | – | 19 U | – | – | – | – | – |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | µg/kg | 35 | 50 | 19 U | – | – | – | 19 U | – | – | – | – | – |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | µg/kg | NE | NE | 19 U | – | – | – | 19 U | – | – | – | – | – |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | µg/kg | 110 | 110 | 37 | – | – | – | 19 U | – | – | – | – | – |
| Hexachlorobenzene | µg/kg | 22 | 70 | 3.4 J | – | – | – | 4.8 U | – | – | – | – | – |
| **Phthalates (OC-Normalized)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | mg/kg OC | 47 | 78 | **7.4** | – | – | – | **10** | – | – | – | – | – |
| Butyl benzyl Phthalate | mg/kg OC | 4.9 | 64 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| Dibutyl Phthalate | mg/kg OC | 220 | 1,700 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| Diethyl Phthalate | mg/kg OC | 61 | 110 | **1** | – | – | – | **3.4** | – | – | – | – | – |
| Dimethyl Phthalate | mg/kg OC | 53 | 53 | 0.61 U | – | – | – | **28** | – | – | – | – | – |
| Di-n-Octyl Phthalate | mg/kg OC | 58 | 4,500 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| **Phthalates (Dry Weight)** | | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | µg/kg | 1,300 | 1,900 | 230 | – | – | – | 96 | – | – | – | – | – |
| Butyl Benzyl Phthalate | µg/kg | 63 | 900 | 19 U | – | – | – | 19 U | – | – | – | – | – |
| Dibutyl Phthalate | µg/kg | 1,400 | 1,400 | 19 U | – | – | – | 19 U | – | – | – | – | – |
| Diethyl Phthalate | µg/kg | 200 | 200 | 30 U | – | – | – | 32 U | – | – | – | – | – |
| Dimethyl Phthalate | µg/kg | 71 | 160 | 19 U | – | – | – | 270 | – | – | – | – | – |
| Di-n-Octyl Phthalate | µg/kg | 6,200 | 6,200 | 19 U | – | – | – | 19 U | – | – | – | – | – |

| | | | Sample Location | SSI-SS-06 | SSI-SC-06 | SSI-SC-06 | SSI-SC-06 | SSI-SS-07 | SSI-SC-07 | SSI-SC-07 | SSI-SC-07 | SSI-SS-08 | SSI-SS-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID: | SSI-SS-06_0-0.39 | SSI-SC-06_0-2 | SSI-SC-06_2-4 | SSI-SC-06_4-6 | SSI-SS-07_0-0.39 | SSI-SC-07_0-2 | SSI-SC-07_2-4 | SSI-SC-07_4-6 | SSI-SS-08_0-0.39 | SSI-SS-09_0-0.39 |
| | | | Date Sampled: | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/12/2015 |
| | | | Depth Interval (ft bml): | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-0.39 ft |
| | | | Elevation at Top of Sample (ft NADV88): | -5.5 | -2.8 | -4.8 | -6.8 | -3.7 | -3.3 | -5.3 | -7.3 | -22.0 | -16.9 |
| | | | Collected By | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | | |
| **Phenols (Dry Weight)** | | | | | | | | | | | | | |
| 2,4-Dimethylphenol | µg/kg | 29 | 29 | **19 J** | – | – | – | 24 U | – | – | – | – | – |
| 2-Methylphenol (o-Cresol) | µg/kg | 63 | 63 | **24** | – | – | – | 19 U | – | – | – | – | – |
| 4-Methylphenol (p-Cresol) | µg/kg | 670 | 670 | **450** | – | – | – | **42** | – | – | – | – | – |
| Pentachlorophenol | µg/kg | 360 | 690 | **360** | **150** | **250** | **52** | 95 U | **18** | **60** | – | – | 85 U |
| Phenol | µg/kg | 420 | 1,200 | **170** | – | – | – | **170** | – | – | – | – | – |
| **Miscellaneous Extractables (OC-Normalized)** | | | | | | | | | | | | | |
| Dibenzofuran | mg/kg OC | 15 | 58 | **10** | – | – | – | **2.4** | – | – | – | – | – |
| Hexachlorobutadiene | mg/kg OC | 3.9 | 6.2 | 0.15 U | – | – | – | 0.5 U | – | – | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | mg/kg OC | 11 | 11 | 0.61 U | – | – | – | 2 U | – | – | – | – | – |
| **Miscellaneous Extractables (Dry Weight)** | | | | | | | | | | | | | |
| Dibenzofuran | µg/kg | 540 | 540 | **300** | – | – | – | **23** | – | – | – | – | – |
| Hexachlorobutadiene | µg/kg | 11 | 120 | 4.8 U | – | – | – | 4.8 U | – | – | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | µg/kg | 28 | 40 | 19 U | – | – | – | 19 U | – | – | – | – | – |
| Benzoic Acid | µg/kg | 650 | 650 | **390** | – | – | – | **110 J** | – | – | – | – | – |
| Benzyl Alcohol | µg/kg | 57 | 730 | **37 J** | – | – | – | 19 U | – | – | – | – | – |
| **Conventionals** | | | | | | | | | | | | | |
| Gravel | Percent | NE | NE | **1.0** | **1.6** | **4.7** | **0.5** | **4.4** | **3.3** | **72.0** | **36.2** | **0.6** | **0.5** |
| Very coarse sand | Percent | NE | NE | **1.1** | **2.4** | **4.1** | **1.4** | **2.7** | **1.0** | **3.5** | **5.5** | **3.6** | **1.0** |
| Coarse sand | Percent | NE | NE | **2.0** | **4.0** | **5.3** | **2.2** | **2.5** | **1.5** | **3.8** | **6.2** | **2.9** | **1.5** |
| Medium sand | Percent | NE | NE | **3.8** | **8.8** | **6.1** | **3.6** | **21.1** | **8.8** | **4.4** | **6.9** | **1.6** | **1.3** |
| Fine sand | Percent | NE | NE | **20.5** | **22.9** | **6.4** | **11.4** | **37.5** | **28.2** | **3.6** | **5.9** | **1.5** | **1.2** |
| Very fine sand | Percent | NE | NE | **43.6** | **23.4** | **10.0** | **26.6** | **19.8** | **32.3** | **4.4** | **12.0** | **2.4** | **1.2** |
| Coarse silt | Percent | NE | NE | **12.7** | **10.5** | **11.9** | **16.5** | **3.7** | **11.5** | 8.3 U | **9.9** | **4.0** | **2.7** |
| Medium silt | Percent | NE | NE | **3.1** | **6.1** | **11.3** | **9.8** | **1.5** | **3.3** | 8.3 U | **4.3** | **31.0** | **22.9** |
| Fine silt | Percent | NE | NE | **3.2** | **4.6** | **9.7** | **6.1** | **2.0** | **2.0** | 8.3 U | **2.5** | **22.6** | **28.1** |
| Very fine silt | Percent | NE | NE | **1.9** | **3.8** | **7.3** | **5.6** | **1.0** | **1.8** | 8.3 U | **2.5** | **6.3** | **10.1** |
| Coarse clay | Percent | NE | NE | **1.6** | **2.9** | **6.7** | **5.1** | **0.8** | **1.6** | 8.3 U | **1.8** | **4.9** | **6.5** |
| Medium clay | Percent | NE | NE | **1.4** | **2.7** | **5.6** | **3.3** | **0.9** | **1.4** | 8.3 U | **1.5** | **5.1** | **7.9** |
| Particle/Grain size, Phi Scale >10 | Percent | NE | NE | **4.2** | **6.3** | **11.1** | **7.9** | **2.0** | **3.3** | 8.3 U | **4.8** | **13.7** | **15.1** |
| Total Fines | Percent | NE | NE | **28.0** | **37.0** | **63.5** | **54.2** | **12.0** | **24.9** | **8.3** | **27.3** | **87.6** | **93.4** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Location | SSI-SS-10 | SSI-SS-11 | SSI-SS-12 | SSI-SS-14 | SSI-SS-15 | SSI-SS-16 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
| | | | Sample ID: | SSI-SS-10_0-0.39 | SSI-SS-11_0-0.39 | SSI-SS-12_0-0.39 | SSI-SS-14_0-0.39 | SSI-SS-15_0-0.39 | SSI-SS-16_0-0.39 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
| | | | Date Sampled: | 10/12/2015 | 10/12/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 6/10/2015 | 6/10/2015 | 6/10/2015 |
| | | | Depth Interval (ft bml): | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.33 ft | 0-0.33 ft | 0-0.33 ft |
| | | | Elevation at Top of Sample (ft NADV88): | -23.5 | -22.7 | -25.1 | -21.4 | -23.7 | -25.6 | -9.3 | -16.9 | -16.8 |
| | | | Collected By | GeoEngineers | | | | | | Landau | | |
| **Parameter** | **Unit(s)** | **SCO/LAET[1]** | **CSL/2LAET[1]** | | | | | | | | | |
| Total Organic Carbon | Percent | 0.5 | 3.5 | **3.09** | **1.84** | **2.12** | **2.46** | **2.00** | **2.05** | – | – | – |
| Total Solids | Percent | NE | NE | **29.13** | **40.90** | **42.77** | **32.27** | **42.12** | **30.63** | **41.69** | – | – |
| **LPAHs (OC-Normalized)** | | | | | | | | | | | | |
| Sum of LPAHs | mg/kg OC | 370 | 780 | – | – | – | – | – | – | – | – | – |
| 2-Methylnaphthalene | mg/kg OC | 38 | 64 | – | – | – | – | – | – | – | – | – |
| Acenaphthene | mg/kg OC | 16 | 57 | – | – | – | – | – | – | – | – | – |
| Acenaphthylene | mg/kg OC | 66 | 66 | – | – | – | – | – | – | – | – | – |
| Anthracene | mg/kg OC | 220 | 1,200 | – | – | – | – | – | – | – | – | – |
| Fluorene | mg/kg OC | 23 | 79 | – | – | – | – | – | – | – | – | – |
| Naphthalene | mg/kg OC | 99 | 170 | – | – | – | – | – | – | – | – | – |
| Phenanthrene | mg/kg OC | 100 | 480 | – | – | – | – | – | – | – | – | – |
| **LPAHs (Dry Weight)** | | | | | | | | | | | | |
| Sum of LPAHs | µg/kg | 5,200 | 5,200 | – | – | – | – | – | – | – | – | – |
| 2-Methylnaphthalene | µg/kg | 670 | 670 | – | – | – | – | – | – | – | – | – |
| Acenaphthene | µg/kg | 500 | 500 | – | – | – | – | – | – | – | – | – |
| Acenaphthylene | µg/kg | 1,300 | 1,300 | – | – | – | – | – | – | – | – | – |
| Anthracene | µg/kg | 960 | 960 | – | – | – | – | – | – | – | – | – |
| Fluorene | µg/kg | 540 | 540 | – | – | – | – | – | – | – | – | – |
| Naphthalene | µg/kg | 2,100 | 2,100 | – | – | – | – | – | – | – | – | – |
| Phenanthrene | µg/kg | 1,500 | 1,500 | – | – | – | – | – | – | – | – | – |
| **HPAHs (OC-Normalized)** | | | | | | | | | | | | |
| Sum of HPAHs | mg/kg OC | 960 | 5,300 | – | – | – | – | – | – | – | – | – |
| Benzo(a)anthracene | mg/kg OC | 110 | 270 | **0.94** | **2** | **1.5** | – | – | – | – | – | – |
| Benzo(a)pyrene | mg/kg OC | 99 | 210 | **0.91** | **1.9** | **1.5** | – | – | – | – | – | – |
| Benzofluoranthenes (Total) | mg/kg OC | 230 | 450 | **2.1** | **4** | **3.1** | – | – | – | – | – | – |
| Benzo(g,h,i)perylene | mg/kg OC | 31 | 78 | – | – | – | – | – | – | – | – | – |
| Chrysene | mg/kg OC | 110 | 460 | **1.5** | **2.9** | **2.1** | – | – | – | – | – | – |
| Dibenzo(a,h)anthracene | mg/kg OC | 12 | 33 | 0.45 U | **0.41** | **0.39** | – | – | – | – | – | – |
| Fluoranthene | mg/kg OC | 160 | 1,200 | – | – | – | – | – | – | – | – | – |
| Indeno(1,2,3-c,d)pyrene | mg/kg OC | 34 | 88 | **0.58** | **1.3** | **0.99** | – | – | – | – | – | – |
| Pyrene | mg/kg OC | 1,000 | 1,400 | – | – | – | – | – | – | – | – | – |

| Sample Location | | | | SSI-SS-10 | SSI-SS-11 | SSI-SS-12 | SSI-SS-14 | SSI-SS-15 | SSI-SS-16 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | | SSI-SS-10_0-0.39 | SSI-SS-11_0-0.39 | SSI-SS-12_0-0.39 | SSI-SS-14_0-0.39 | SSI-SS-15_0-0.39 | SSI-SS-16_0-0.39 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
| Date Sampled: | | | | 10/12/2015 | 10/12/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 6/10/2015 | 6/10/2015 | 6/10/2015 |
| Depth Interval (ft bml): | | | | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.33 ft | 0-0.33 ft | 0-0.33 ft |
| Elevation at Top of Sample (ft NADV88): | | | | -23.5 | -22.7 | -25.1 | -21.4 | -23.7 | -25.6 | -9.3 | -16.9 | -16.8 |
| Collected By | | | | GeoEngineers | | | | | | Landau | | |
| Parameter | Unit(s) | SCO/LAET[1] | CSL/2LAET[1] | | | | | | | | | |
| **HPAHs (Dry Weight)** | | | | | | | | | | | | |
| Sum of HPAHs | µg/kg | 12,000 | 17,000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Benzo(a)anthracene | µg/kg | 1,300 | 1,600 | 29 | 37 | 32 | -- | -- | -- | -- | -- | -- |
| Benzo(a)pyrene | µg/kg | 1,600 | 1,600 | 28 | 35 | 31 | -- | -- | -- | -- | -- | -- |
| Benzofluoranthenes (Total) | µg/kg | 3,200 | 3,600 | 64 | 74 | 66 | -- | -- | -- | -- | -- | -- |
| Benzo(g,h,i)perylene | µg/kg | 670 | 720 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chrysene | µg/kg | 1,400 | 2,800 | 45 | 53 | 44 | -- | -- | -- | -- | -- | -- |
| Dibenzo(a,h)anthracene | µg/kg | 230 | 230 | 14 U | 7.5 J | 8.2 J | -- | -- | -- | -- | -- | -- |
| Fluoranthene | µg/kg | 1,700 | 2,500 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Indeno(1,2,3-c,d)pyrene | µg/kg | 600 | 690 | 18 | 24 | 21 | -- | -- | -- | -- | -- | -- |
| Pyrene | µg/kg | 2,600 | 3,300 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Petroleum Hydrocarbons (Dry Weight)** | | | | | | | | | | | | |
| Diesel Fuel | mg/kg | 260 | 260 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Motor Oil | mg/kg | 260 | 260 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Petroleum Hydrocarbons (Total) | mg/kg | 260 | 260 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Chlorinated Hydrocarbons (OC-Normalized)** | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | mg/kg OC | 0.81 | 1.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | mg/kg OC | 2.3 | 2.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | mg/kg OC | NE | NE | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | mg/kg OC | 3.1 | 9 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Hexachlorobenzene | mg/kg OC | 0.38 | 2.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Chlorinated Hydrocarbons (Dry Weight)** | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | µg/kg | 31 | 51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dichlorobenzene (o-Dichlorobenzene) | µg/kg | 35 | 50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Dichlorobenzene (m-Dichlorobenzene) | µg/kg | NE | NE | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,4-Dichlorobenzene (p-Dichlorobenzene) | µg/kg | 110 | 110 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Hexachlorobenzene | µg/kg | 22 | 70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Phthalates (OC-Normalized)** | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | mg/kg OC | 47 | 78 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Butyl benzyl Phthalate | mg/kg OC | 4.9 | 64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Dibutyl Phthalate | mg/kg OC | 220 | 1,700 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Diethyl Phthalate | mg/kg OC | 61 | 110 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Dimethyl Phthalate | mg/kg OC | 53 | 53 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Di-n-Octyl Phthalate | mg/kg OC | 58 | 4,500 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Phthalates (Dry Weight)** | | | | | | | | | | | | |
| Bis(2-Ethylhexyl) Phthalate | µg/kg | 1,300 | 1,900 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Butyl Benzyl Phthalate | µg/kg | 63 | 900 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Dibutyl Phthalate | µg/kg | 1,400 | 1,400 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Diethyl Phthalate | µg/kg | 200 | 200 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Dimethyl Phthalate | µg/kg | 71 | 160 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Di-n-Octyl Phthalate | µg/kg | 6,200 | 6,200 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

| Sample Location | | | | SSI-SS-10 | SSI-SS-11 | SSI-SS-12 | SSI-SS-14 | SSI-SS-15 | SSI-SS-16 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | | SSI-SS-10_0-0.39 | SSI-SS-11_0-0.39 | SSI-SS-12_0-0.39 | SSI-SS-14_0-0.39 | SSI-SS-15_0-0.39 | SSI-SS-16_0-0.39 | CL-SG-1 | CL-SG-3 | CL-SG-4 |
| Date Sampled: | | | | 10/12/2015 | 10/12/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 6/10/2015 | 6/10/2015 | 6/10/2015 |
| Depth Interval (ft bml): | | | | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.33 ft | 0-0.33 ft | 0-0.33 ft |
| Elevation at Top of Sample (ft NADV88): | | | | -23.5 | -22.7 | -25.1 | -21.4 | -23.7 | -25.6 | -9.3 | -16.9 | -16.8 |
| Collected By | | | | GeoEngineers | | | | | | Landau | | |
| Parameter | Unit(s) | SCO/LAET[1] | CSL/2LAET[1] | | | | | | | | | |
| **Phenols (Dry Weight)** | | | | | | | | | | | | |
| 2,4-Dimethylphenol | µg/kg | 29 | 29 | – | – | – | – | – | – | – | – | – |
| 2-Methylphenol (o-Cresol) | µg/kg | 63 | 63 | – | – | – | – | – | – | – | – | – |
| 4-Methylphenol (p-Cresol) | µg/kg | 670 | 670 | – | – | – | – | – | – | – | – | – |
| Pentachlorophenol | µg/kg | 360 | 690 | – | – | – | – | – | – | – | – | – |
| Phenol | µg/kg | 420 | 1,200 | – | – | – | – | – | – | – | – | – |
| **Miscellaneous Extractables (OC-Normalized)** | | | | | | | | | | | | |
| Dibenzofuran | mg/kg OC | 15 | 58 | – | – | – | – | – | – | – | – | – |
| Hexachlorobutadiene | mg/kg OC | 3.9 | 6.2 | – | – | – | – | – | – | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | mg/kg OC | 11 | 11 | – | – | – | – | – | – | – | – | – |
| **Miscellaneous Extractables (Dry Weight)** | | | | | | | | | | | | |
| Dibenzofuran | µg/kg | 540 | 540 | – | – | – | – | – | – | – | – | – |
| Hexachlorobutadiene | µg/kg | 11 | 120 | – | – | – | – | – | – | – | – | – |
| n-Nitrosodiphenylamine (as diphenylamine) | µg/kg | 28 | 40 | – | – | – | – | – | – | – | – | – |
| Benzoic Acid | µg/kg | 650 | 650 | – | – | – | – | – | – | – | – | – |
| Benzyl Alcohol | µg/kg | 57 | 730 | – | – | – | – | – | – | – | – | – |
| **Conventionals** | | | | | | | | | | | | |
| Gravel | Percent | NE | NE | **0.7** | **1.1** | **1.2** | **0.4** | **1.7** | **0.6** | **4.5** | **0.4** | – |
| Very coarse sand | Percent | NE | NE | **4.8** | **1.5** | **0.4** | **2.9** | **0.7** | **0.3** | **5.1** | **1.0** | – |
| Coarse sand | Percent | NE | NE | **3.5** | **1.6** | **1.4** | **3.0** | **1.3** | **1.8** | **5.7** | **1.8** | – |
| Medium sand | Percent | NE | NE | **1.5** | **1.2** | **1.0** | **1.4** | **0.8** | **1.4** | **5.7** | **1.5** | – |
| Fine sand | Percent | NE | NE | **1.1** | **0.8** | **0.9** | **1.0** | **0.7** | **1.0** | **12.6** | **1.2** | – |
| Very fine sand | Percent | NE | NE | **0.9** | **0.8** | **0.9** | **1.1** | **0.9** | **1.0** | **16.7** | **1.6** | – |
| Coarse silt | Percent | NE | NE | **1.9** | **2.9** | **1.5** | **4.8** | **10.8** | **4.9** | **3.5** | **2.6** | – |
| Medium silt | Percent | NE | NE | **34.8** | **27.1** | **28.2** | **44.4** | **14.9** | **41.7** | **6.8** | **10.3** | – |
| Fine silt | Percent | NE | NE | **19.4** | **26.8** | **26.8** | **15.8** | **26.9** | **20.1** | **8.6** | **21.0** | – |
| Very fine silt | Percent | NE | NE | **7.9** | **9.1** | **10.1** | **5.8** | **11.0** | **6.6** | **7.9** | **16.5** | – |
| Coarse clay | Percent | NE | NE | **4.8** | **5.7** | **6.2** | **3.5** | **8.6** | **4.0** | **6.8** | **12.6** | – |
| Medium clay | Percent | NE | NE | **5.5** | **6.8** | **7.1** | **4.6** | **6.2** | **4.0** | **5.5** | **10.4** | – |
| Particle/Grain size, Phi Scale >10 | Percent | NE | NE | **13.4** | **14.5** | **14.3** | **11.4** | **15.6** | **12.5** | **10.5** | **19.0** | – |
| Total Fines | Percent | NE | NE | **87.5** | **92.9** | **94.2** | **90.1** | **94.0** | **93.7** | **49.8** | **92.4** | – |

Notes:

[1] The screening levels provided are the Sediment Management Standards (SMS) Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) and the Lowest Apparent Effects Threshold (LAET) and 2nd Lowest Apparent Effects Threshold (2LAET) values except for petroleum hydrocarbons. SMS criteria have not been established for petroleum hydrocarbons; the screening level is based on bioassay tests and chemical analyses performed as part of the RG Haley remedial investigation (GeoEngineers 2016). LAET and 2LAET values are provided for comparison to dry weight concentrations for LPAHs, HPAHs, chlorinated organics, phthalates, and miscellaneous extractables when the total organic carbon content for a specific sample is outside of the range (0.5 percent to 3.5 percent) recommended for TOC normalization.

[2] Preliminary cleanup levels (PCULs) are those identified in the Feasibility Study and are provided for reference.

Total organic carbon (TOC) concentration is less than 0.5 percent or greater than 3.5 percent.

Do not evaluate screening level exceedances on this basis.

Value is greater than SCO or LAET.

Value is greater than CSL or 2LAET.

Detection limit is greater than screening level.

**Bold** indicates that the analyte was detected.

bml = below mudline

mg/kg = milligrams per kilogram

mg/kg OC = milligrams per kilogram organic carbon

ng/kg = nanograms per kilogram

µg/kg = micrograms per kilogram

J = Estimated value

U = Not detected at or above identified detection limit

UJ = Compound analyzed, but not detected above estimated detection limit

NJ = The analyte has been "tentatively identified" and the associated numerical value is the estimated concentration in the sample.

-- = Sample was not submitted for the identified chemical analysis

NE = A criterion has not been established for the identified analyte

SMS = Sediment Management Standards

SCO = SMS Sediment Cleanup Objective (Chapter 173-204-320)

CSL = SMS Cleanup Screening Level (Chapter 173-204-520)

LAET = Lowest Apparent Effects Threshold (LAET). The LAET (expressed on a dry-weight basis) is analogous to the SMS SCO value for samples and is used as the sediment screening level where the sample-specific total organic carbon concentration is less than 0.5 percent or greater than 3.5 percent.

2LAET = Second Lowest Apparent Effects Threshold (2LAET). The 2LAET (expressed on a dry-weight basis) is analogous to the SMS CSL value and is used as the screening level for samples where the total organic carbon concentration is less than 0.5 percent or greater than 3.5 percent.

LPAH = Low molecular weight polycyclic aromatic hydrocarbons (PAHs)

HPAH = High molecular weight polycyclic aromatic hydrocarbons (PAHs)

Total LPAH is the sum of detected concentrations of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene.

Total HPAH is the sum of detected concentrations of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b+j+k)fluoranthenes, benzo(a)pyrene, indeno(1,2,3-c-d)pyrene, dibenzo(a,h)anthracene and benzo(g,h,i)perylene.

The totals for LPAH and HPAH are the sum of all detected results. If no individual LPAHs or HPAHs were detected, the highest detection limit value is reported as the total.

# Table 4

## 2013-2016 Sediment Analytical Results Compared to Bioaccumulative Screening Levels for Protection of Human Health, Fish and Wildlife

R.G Haley Site

Bellingham, Washington

| Sample Location | | | PSB-01 | PSB-02 | PSB-02 | PSB-03 | PSB-03 | PSB-04 | SSI-SS-01 | SSI-SC-01 | SSI-SC-01 | SSI-SS-02 | SSI-SS-03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | PSB-SC-01-0-1 | PSB-SC-02-0-1 | PSB-SC-02-1-2 | PSB-SC-03-0-1 | PSB-SC-03-1-2 | PSB-SC-04-0-1 | SSI-SS-01_0-0.39 | SSI-SC-01_0-2 | SSI-SC-01_2-4 | SSI-SS-02_0-0.39 | SSI-SS-03_0-0.39 |
| Date Sampled: | | | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 2/18/2016 | 10/15/2015 | 10/14/2015 | 10/14/2015 | 10/15/2015 | 10/15/2015 |
| Depth Interval (ft bml): | | | 0-1 ft | 0-1 ft | 1-2 ft | 0-1 ft | 1-2 ft | 0-1 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-0.39 ft |
| Elevation at Top of Sample (ft NADV88): | | | 4.3 | 1.3 | 0.3 | 6.1 | 5.1 | 4.7 | -5.2 | -5.9 | -7.9 | -0.5 | -8.3 |
| Collected By | | | GeoEngineers | | | | | | | | | | |
| **Parameter** | **Unit(s)** | **CULs[1]** | | | | | | | | | | | |
| **Dioxin/Furans** | | | | | | | | | | | | | |
| 2,3,7,8-TCDD | ng/kg | NE | **0.449 J** | **0.254 J** | **0.374 J** | **0.249 J** | **0.930 J** | **2.11** | -- | **3.19** | **3.38** | **0.652 J** | -- |
| 2,3,7,8-TCDF | ng/kg | NE | **0.496 J** | **0.348 J** | **0.370 J** | **0.281 J** | **0.919 J** | **0.598 J** | -- | **5.02** | **4.80** | **0.921 J** | -- |
| 1,2,3,7,8-PeCDD | ng/kg | NE | **2.06 J** | **1.51 J** | **4.71 J** | **0.947 J** | **2.53 J** | **4.11 J** | -- | **12.7** | **13.9** | **2.60 J** | -- |
| 1,2,3,7,8-PeCDF | ng/kg | NE | **1.28 J** | **0.954 J** | **1.51 J** | **0.592 J** | **3.22 J** | **1.35 J** | -- | **6.68** | **6.21** | **1.26 J** | -- |
| 2,3,4,7,8-PeCDF | ng/kg | NE | **2.07 J** | **1.89 J** | **1.70 J** | **1.19 J** | **3.11 J** | **2.60 J** | -- | **5.96** | **5.56** | **1.24 J** | -- |
| 1,2,3,4,7,8-HxCDD | ng/kg | NE | **5.74** | **3.38 J** | **6.92** | **2.22 J** | **6.92** | **7.33** | -- | **20.8** | **29.2** | **6.49** | -- |
| 1,2,3,4,7,8-HxCDF | ng/kg | NE | **11.7** | **5.16** | **5.17** | **3.25 J** | **21.1** | **7.85** | -- | **35.5** | **28.5** | **5.37** | -- |
| 1,2,3,6,7,8-HxCDD | ng/kg | NE | **35.1** | **15.0** | **48.9** | **11.1** | **64.3** | **23.1** | -- | **126** | **91.6** | **17.8** | -- |
| 1,2,3,6,7,8-HxCDF | ng/kg | NE | **3.74 J** | **1.75 J** | **2.33 J** | **1.25 J** | **5.62** | **2.97 J** | -- | **10.5** | **9.87** | **2.21 J** | -- |
| 1,2,3,7,8,9-HxCDD | ng/kg | NE | **9.99** | **5.01** | **9.76** | **4.29 J** | **13.0** | **12.2** | -- | **43.4** | **45.6** | **9.40** | -- |
| 1,2,3,7,8,9-HxCDF | ng/kg | NE | **3.63 J** | **1.96 J** | **3.12 J** | **1.98 J** | **7.86** | **2.71 J** | -- | **9.45** | **9.17** | **1.77 J** | -- |
| 2,3,4,6,7,8-HxCDF | ng/kg | NE | **5.62** | **2.67 J** | **3.43 J** | **2.02 J** | **10.2** | **4.80 J** | -- | **17.4** | **15.7** | **3.74 J** | -- |
| 1,2,3,4,6,7,8-HpCDD | ng/kg | NE | **1,260** | **386** | **539** | **334** | **2,410** | **625** | -- | **6,000 J** | **2,220** | **429** | -- |
| 1,2,3,4,6,7,8-HpCDF | ng/kg | NE | **185** | **65.9** | **76.1** | **64.5** | **368** | **105** | -- | **578 J** | **256** | **38.6** | -- |
| 1,2,3,4,7,8,9-HpCDF | ng/kg | NE | **13.2** | **4.44 J** | **5.39** | **4.15 J** | **21.7** | **6.67** | -- | **29.2 J** | **15.9** | **2.95 J** | -- |
| OCDD | ng/kg | NE | **23,500** | **4,330** | **4,090** | **3,880** | **38,600** | **5,630** | -- | **68,000 J** | **20,100** | **4,310** | -- |
| OCDF | ng/kg | NE | **826** | **265** | **276** | **298** | **1,750** | **333** | -- | **3,050 J** | **642** | **92.5** | -- |
| Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | ng/kg | 13 | **32.6 J** | **11.8 J** | **21.2 J** | **9.49 J** | **57.6 J** | **22.4 J** | -- | **132 J** | **73.7** | **14.5 J** | -- |
| **cPAH (Dry Weight)** | | | | | | | | | | | | | |
| Total cPAH TEQ (ND=0.5RL) | µg/kg | 229 | **11.6** | **13.4 J** | **38.3** | **8.28** | **4.45 J** | **10.5** | **195 J** | **286** | **237** | **19.6 J** | **1,140** |
| **Phenols (Dry Weight)** | | | | | | | | | | | | | |
| Pentachlorophenol | µg/kg | 100 | **18** | **12** | **26 NJ** | **19 NJ** | **20** | **33** | 94 U | **52** | **160 NJ** | 93 U | **170** |

| Sample Location | | | SSI-SC-03 | SSI-SC-03 | SSI-SS-04 | SSI-SC-04 | SSI-SC-04 | SSI-SS-05 | SSI-SC-05 | SSI-SC-05 | SSI-SC-05 | SSI-SS-06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | SSI-SC-03_0-2 | SSI-SC-03_2-4 | SSI-SS-04-0_12 | SSI-SC-04_0-2 | SSI-SC-04_2-4 | SSI-SS-05_0-0.39 | SSI-SC-05_0-2 | SSI-SC-05_2-4 | SSI-SC-05_4-6 | SSI-SS-06_0-0.39 |
| Date Sampled: | | | 10/14/2015 | 10/14/2015 | 10/15/2015 | 10/15/2015 | 10/15/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 |
| Depth Interval (ft bml): | | | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft |
| Elevation at Top of Sample (ft NADV88): | | | -3.1 | -5.1 | -0.5 | 0.4 | -1.6 | -4.9 | -3.5 | -5.5 | -7.5 | -5.5 |
| Collected By | | | GeoEngineers | | | | | | | | | |
| **Parameter** | **Unit(s)** | **CULs[1]** | | | | | | | | | | |
| **Dioxin/Furans** | | | | | | | | | | | | |
| 2,3,7,8-TCDD | ng/kg | NE | 2.23 | 1.33 | – | 0.748 J | 0.821 J | – | 5.16 | 1.60 | 0.145 U | – |
| 2,3,7,8-TCDF | ng/kg | NE | 4.37 | 2.19 | – | 1.80 | 2.76 | – | 12.3 | 8.50 | 0.536 J | – |
| 1,2,3,7,8-PeCDD | ng/kg | NE | 10.5 | 4.96 | – | 3.91 J | 2.96 J | – | 25.0 | 6.16 | 0.492 J | – |
| 1,2,3,7,8-PeCDF | ng/kg | NE | 4.22 J | 2.18 J | – | 3.69 J | 2.79 J | – | 15.5 | 6.18 | 0.469 J | – |
| 2,3,4,7,8-PeCDF | ng/kg | NE | 3.56 J | 1.91 J | – | 3.96 J | 2.32 J | – | 13.9 | 4.38 J | 0.920 J | – |
| 1,2,3,4,7,8-HxCDD | ng/kg | NE | 20.2 | 9.83 | – | 8.64 | 5.49 | – | 56.2 | 13.7 | 1.08 J | – |
| 1,2,3,4,7,8-HxCDF | ng/kg | NE | 14.7 | 8.75 | – | 22.7 | 17.6 | – | 74.4 | 22.0 | 1.37 J | – |
| 1,2,3,6,7,8-HxCDD | ng/kg | NE | 55.6 | 31.9 | – | 47.1 | 32.5 | – | 231 | 61.6 | 3.61 J | – |
| 1,2,3,6,7,8-HxCDF | ng/kg | NE | 6.09 | 3.66 J | – | 7.74 | 5.90 | – | 28.4 | 9.34 | 0.711 J | – |
| 1,2,3,7,8,9-HxCDD | ng/kg | NE | 28.3 | 15.4 | – | 18.4 | 11.6 | – | 83.6 | 23.7 | 1.72 J | – |
| 1,2,3,7,8,9-HxCDF | ng/kg | NE | 4.17 J | 2.58 J | – | 6.73 | 4.90 J | – | 23.0 | 6.14 | 0.606 J | – |
| 2,3,4,6,7,8-HxCDF | ng/kg | NE | 9.58 | 6.97 | – | 13.9 | 11.6 | – | 49.5 | 14.5 | 1.29 J | – |
| 1,2,3,4,6,7,8-HpCDD | ng/kg | NE | 1,160 | 858 | – | 1,070 | 738 | – | 5,190 | 1,260 | 62.6 | – |
| 1,2,3,4,6,7,8-HpCDF | ng/kg | NE | 160.0 | 93.0 | – | 280.0 | 249 | – | 1,120 | 287 | 12.6 | – |
| 1,2,3,4,7,8,9-HpCDF | ng/kg | NE | 9.53 | 5.00 | – | 17.5 | 15.7 | – | 62.5 | 16.7 | 1.07 J | – |
| OCDD | ng/kg | NE | 10,400 | 7,390 | – | 9,040 | 5,770 | – | 42,400 | 10,300 | 482 | – |
| OCDF | ng/kg | NE | 443 | 241 | – | 976 | 885 | – | 4,210 | 918 | 39.8 | – |
| Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | ng/kg | 13 | 44.8 J | 26.9 J | – | 35.3 J | 25.8 J | – | 168 | 44.2 J | 2.87 J | – |
| **cPAH (Dry Weight)** | | | | | | | | | | | | |
| Total cPAH TEQ (ND=0.5RL) | µg/kg | 229 | 210 | 103 | 13 J | 179 | 488 | 334 | 1,022 | 669 | 34 | 447 |
| **Phenols (Dry Weight)** | | | | | | | | | | | | |
| Pentachlorophenol | µg/kg | 100 | 150 NJ | 46 NJ | 94 U | 23 NJ | 54 | 580 | 140 | 59 NJ | – | 360 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | | | SSI-SC-06 | SSI-SC-06 | SSI-SC-06 | SSI-SS-07 | SSI-SC-07 | SSI-SC-07 | SSI-SC-07 | SSI-SS-08 | SSI-SS-09 | SSI-SS-10 | SSI-SS-11 |
| Sample ID: | | | SSI-SC-06_0-2 | SSI-SC-06_2-4 | SSI-SC-06_4-6 | SSI-SS-07_0-0.39 | SSI-SC-07_0-2 | SSI-SC-07_2-4 | SSI-SC-07_4-6 | SSI-SS-08_0-0.39 | SSI-SS-09_0-0.39 | SSI-SS-10_0-0.39 | SSI-SS-11_0-0.39 |
| Date Sampled: | | | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 10/12/2015 | 10/12/2015 | 10/12/2015 | 10/12/2015 |
| Depth Interval (ft bml): | | | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-2 ft | 2-4 ft | 4-6 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft |
| Elevation at Top of Sample (ft NADV88): | | | -2.8 | -4.8 | -6.8 | -3.7 | -3.3 | -5.3 | -7.3 | -22.0 | -16.9 | -23.5 | -22.7 |
| Collected By | | | GeoEngineers | | | | | | | | | | |
| **Parameter** | **Unit(s)** | **CULs[1]** | | | | | | | | | | | |
| **Dioxin/Furans** | | | | | | | | | | | | | |
| 2,3,7,8-TCDD | ng/kg | NE | **11.7** | **8.37** | **2.28** | -- | **0.726 J** | **0.759 J** | **1.24** | **0.587 J** | -- | **0.744 J** | **1.02** |
| 2,3,7,8-TCDF | ng/kg | NE | **16.6** | **15.6** | **9.97** | -- | **4.80** | **6.49** | **11.5** | **4.12** | -- | **9.57** | **17.6** |
| 1,2,3,7,8-PeCDD | ng/kg | NE | **66.8** | **61.7** | **8.12** | -- | **3.08 J** | **3.54 J** | **6.90** | **2.17 J** | -- | **3.38 J** | **4.46 J** |
| 1,2,3,7,8-PeCDF | ng/kg | NE | **36.5** | **12.7** | **5.92** | -- | **4.75 J** | **9.90** | **16.3** | **1.50 J** | -- | **1.92 J** | **2.38 J** |
| 2,3,4,7,8-PeCDF | ng/kg | NE | **40.3** | **13.2** | **6.22** | -- | **3.66 J** | **8.64** | **10.8** | **2.02 J** | -- | **1.53 J** | **2.57 J** |
| 1,2,3,4,7,8-HxCDD | ng/kg | NE | **159** | **144** | **13.2** | -- | **6.44** | **6.32** | **13.2** | **5.47** | -- | **10.3** | **16.6** |
| 1,2,3,4,7,8-HxCDF | ng/kg | NE | **184** | **140.0** | **17.9** | -- | **16.8** | **36.9** | **61.4** | **7.08** | -- | **6.12** | **5.92** |
| 1,2,3,6,7,8-HxCDD | ng/kg | NE | **504** | **847** | **73.6** | -- | **37.6** | **56.1** | **108** | **20.1** | -- | **23.9** | **31.0** |
| 1,2,3,6,7,8-HxCDF | ng/kg | NE | 74.9 U | **62.6** | **10.9** | -- | **5.36 J** | **9.56** | **20.1** | **2.54 J** | -- | **2.66 J** | 2.89 U |
| 1,2,3,7,8,9-HxCDD | ng/kg | NE | **244** | **256** | **24.7** | -- | **12.4** | **14.5** | **29.8** | **8.03** | -- | **12.3** | **18.3** |
| 1,2,3,7,8,9-HxCDF | ng/kg | NE | **60.6** | **14.4** | **3.78 J** | -- | **4.71 J** | **9.40** | **17.1** | **2.53 J** | -- | **2.18 J** | **1.94 J** |
| 2,3,4,6,7,8-HxCDF | ng/kg | NE | **120.0** | **140.0** | **19.3** | -- | **8.32** | **12.8** | **23.4** | **3.81 J** | -- | **4.21 J** | **3.99 J** |
| 1,2,3,4,6,7,8-HpCDD | ng/kg | NE | **12,100** | **22,600** | **1,200** | -- | **755** | **1,230** | **2,050** | **471** | -- | **442** | **436** |
| 1,2,3,4,6,7,8-HpCDF | ng/kg | NE | **3,310** | **8,310** | **532** | -- | **140.0** | **213** | **400.0** | **61.6** | -- | **64.0** | **68.2** |
| 1,2,3,4,7,8,9-HpCDF | ng/kg | NE | **170.0** | **307** | **31.8** | -- | **7.81** | **12.2** | **28.7** | **4.58 J** | -- | **4.23 J** | **4.53 J** |
| OCDD | ng/kg | NE | **80,600 J** | **163,000 J** | **7,370** | -- | **6,390** | **13,700** | **21,300** | **3,900** | -- | **3,720** | **3,050** |
| OCDF | ng/kg | NE | **11,000** | **33,800** | **1,670** | -- | **329** | **466** | **1070** | **204** | -- | **227** | **248** |
| Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | ng/kg | 13 | **411 J** | **608 J** | **50.1 J** | -- | **25.7 J** | **41.2 J** | **71.8** | **15.4 J** | -- | **18.1 J** | **22.2 J** |
| **cPAH (Dry Weight)** | | | | | | | | | | | | | |
| Total cPAH TEQ (ND=0.5RL) | µg/kg | 229 | **308** | **764** | **315** | **37.3 J** | **109** | **551** | **661** | -- | **64 J** | **40.3** | **49.8 J** |
| **Phenols (Dry Weight)** | | | | | | | | | | | | | |
| Pentachlorophenol | µg/kg | 100 | **150** | **250** | **52** | 95 U | **18** | **60** | -- | -- | 85 U | -- | -- |

| Parameter | Unit(s) | CULs[1] | SSI-SS-12 | SSI-SS-14 | SSI-SS-15 | SSI-SS-16 | CL-SG-1 | CL-SG-3 | CL-SG-4 | COB-CC-C1 | COB-CC-C2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | | | SSI-SS-12 | SSI-SS-14 | SSI-SS-15 | SSI-SS-16 | CL-SG-1 | CL-SG-3 | CL-SG-4 | COB-CC-C1 | COB-CC-C2 |
| Sample ID: | | | SSI-SS-12_0-0.39 | SSI-SS-14_0-0.39 | SSI-SS-15_0-0.39 | SSI-SS-16_0-0.39 | CL-SG-1 | CL-SG-3 | CL-SG-4 | COB-CC-C1 | COB-CC-C2 |
| Date Sampled: | | | 10/12/2015 | 10/13/2015 | 10/13/2015 | 10/13/2015 | 6/10/2015 | 6/10/2015 | 6/10/2015 | 8/17/2013 | 8/17/2013 |
| Depth Interval (ft bml): | | | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.39 ft | 0-0.33 ft | 0-0.33 ft | 0-0.33 ft | 0-1 ft | 0-1 ft |
| Elevation at Top of Sample (ft NADV88): | | | -25.1 | -21.4 | -23.7 | -25.6 | -9.3 | -16.9 | -16.8 | composite sample | composite sample |
| Collected By | | | GeoEngineers | | | | Landau | | | GeoEngineers | |
| **Dioxin/Furans** | | | | | | | | | | | |
| 2,3,7,8-TCDD | ng/kg | NE | **0.965 J** | **1.02** | **0.946 J** | **0.759 J** | 1.81 U | 1.10 U | 2.28 U | **1.83** | **1.83** |
| 2,3,7,8-TCDF | ng/kg | NE | **12.3** | **13.9** | **10.5** | **13.4** | **8.48** | **13.0** | **16.2** | **1.00** | **1.16** |
| 1,2,3,7,8-PeCDD | ng/kg | NE | **3.78 J** | **5.80** | **3.54 J** | **3.66 J** | **4.09** | **5.50** | **12.1** | **6.41** | **7.26** |
| 1,2,3,7,8-PeCDF | ng/kg | NE | **1.70 J** | **3.33 J** | **2.90 J** | **2.12 J** | **1.84** | **2.26** | **4.51** | **2.18** | **2.49** |
| 2,3,4,7,8-PeCDF | ng/kg | NE | **1.66 J** | **4.33 J** | **3.49 J** | **1.66 J** | **1.91** | **2.73** | **5.82** | **1.91** | **2.68** |
| 1,2,3,4,7,8-HxCDD | ng/kg | NE | **11.8** | **13.9** | **12.1** | **11.6** | **5.60** | **11.9** | **19.7** | **12.4** | **12.6** |
| 1,2,3,4,7,8-HxCDF | ng/kg | NE | **4.21 J** | **12.5** | **8.25** | **4.90 J** | **4.36 J** | **7.66** | **17.8** | **8.44** | **14.9** |
| 1,2,3,6,7,8-HxCDD | ng/kg | NE | **21.6** | **33.5** | **26.1** | **20.3** | **19.4** | **30.8** | **59.8** | **28.2** | **43.4** |
| 1,2,3,6,7,8-HxCDF | ng/kg | NE | **2.48 J** | **5.15** | **3.82 J** | **2.30 J** | 2.09 U | **3.32** | **7.00** | **3.29** | **5.53** |
| 1,2,3,7,8,9-HxCDD | ng/kg | NE | **13.0** | **18.0** | **13.4** | **11.5** | **8.40** | **16.8** | **29.3** | **12.9** | **19.2** |
| 1,2,3,7,8,9-HxCDF | ng/kg | NE | **1.44 J** | **4.33 J** | **2.88 J** | **1.73 J** | **1.58** | **2.79** | **6.38** | **3.24** | **4.92** |
| 2,3,4,6,7,8-HxCDF | ng/kg | NE | **2.83 J** | **6.92** | **5.18** | **3.42 J** | 1.59 UJ | 2.59 U | **9.62** | **5.42** | **8.75** |
| 1,2,3,4,6,7,8-HpCDD | ng/kg | NE | **337** | **565** | **422** | **255** | **341** | **660** | **1,420** | **675** | **1,060** |
| 1,2,3,4,6,7,8-HpCDF | ng/kg | NE | **45.2** | **104** | **79.4** | **43.9** | **58.2** | **103** | **189** | **110** | **225** |
| 1,2,3,4,7,8,9-HpCDF | ng/kg | NE | **3.29 J** | **8.53** | **6.45** | **3.91 J** | 4.04 U | **6.59** | **12.2** | **7.24** | **14.2** |
| OCDD | ng/kg | NE | **2,330** | **4,720** | **3,480** | **1,780** | **2,730** | **5,700 J** | **13,600 J** | **5,780 J** | **9,380 J** |
| OCDF | ng/kg | NE | **158** | **355** | **267** | **148** | **170** | **440** | **735** | **410** | **924** |
| Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | ng/kg | 13 | **16.9 J** | **27.3 J** | **20.0 J** | **15.5 J** | **15.5 J** | **25.2 J** | **52.2 J** | **26.1 J** | **37.1 J** |
| **cPAH (Dry Weight)** | | | | | | | | | | | |
| Total cPAH TEQ (ND=0.5RL) | µg/kg | 229 | **44.2 J** | -- | -- | -- | -- | -- | -- | -- | -- |
| **Phenols (Dry Weight)** | | | | | | | | | | | |
| Pentachlorophenol | µg/kg | 100 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

Notes:

[1] Cleanup levels for dioxins/furans and carcinogenic PAHs are based on protection of human health and ecological receptors. Cleanup level for pentachlorophenol is based on the practical quantitation limit.

Value is greater than the cleanup level.

**Bold** indicates that the analyte was detected.

bml = below mudline

mg/kg = milligrams per kilogram

mg/kg OC = milligrams per kilogram organic carbon

ng/kg = nanograms per kilogram

µg/kg = micrograms per kilogram

J = Estimated value

U = Not detected at or above identified detection limit

UJ = Compound analyzed, but not detected above estimated detection limit

NJ = The analyte has been "tentatively identified" and the associated numerical value is the estimated concentration in the sample.

-- = Sample was not submitted for the identified chemical analysis

NE = A criterion has not been established for the identified analyte

PCUL = Preliminary cleanup level

SMS = Sediment Management Standards

SCO = SMS Sediment Cleanup Objective (Chapter 173-204-320)

CSL = SMS Cleanup Screening Level (Chapter 173-204-520)

LAET = Lowest Apparent Effects Threshold (LAET). The LAET (expressed on a dry-weight basis) is analogous to the SMS SCO value for samples and is used as the sediment screening level where the sample-specific total organic carbon concentration is less than 0.5 percent or greater than 3.5 percent.

2LAET = Second Lowest Apparent Effects Threshold (2LAET). The 2LAET (expressed on a dry-weight basis) is analogous to the SMS CSL value and is used as the screening level for samples where the total organic carbon concentration is less than 0.5 percent or greater than 3.5 percent.

LPAH = Low molecular weight polycyclic aromatic hydrocarbons (PAHs)

HPAH = High molecular weight polycyclic aromatic hydrocarbons (PAHs)

Total LPAH is the sum of detected concentrations of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene.

Total HPAH is the sum of detected concentrations of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b+j+k)fluoranthenes, benzo(a)pyrene, indeno(1,2,3-c-d)pyrene, dibenzo(a,h)anthracene and benzo(g,h,i)perylene.

The totals for LPAH and HPAH are the sum of all detected results. If no individual LPAHs or HPAHs were detected, the highest detection limit value is reported as the total.

# Table 5

## Sediment Bioassay Summary Results

R.G. Haley Site
Bellingham, Washington

| Sample ID | SCO Pass/Fail | | | CSL Pass/Fail | | |
|---|---|---|---|---|---|---|
| | Larval Toxicity Test (*Mytilus galloprovincialis* )[1] | Juvenile Polychaete 20-Day Toxicity Test (*Neanthes arenaceodentata* )[2] | Amphipod 10-Day Toxicity Test (*Eohaustorius estuarius)* [3] | Larval Toxicity Test (*Mytilus galloprovincialis* )[4] | Juvenile Polychaete 20-Day Toxicity Test (*Neanthes arenaceodentata* )[5] | Amphipod 10-Day Acute Toxicity Test (*Eohaustorius estuarius)* [6] |
| SSI-SS-03 | Pass | Pass | Pass | Pass | Pass | Pass |
| SSI-SS-05 | Pass | Pass | Pass | Pass | Pass | Pass |
| SSI-SS-06 | Pass | Pass | Pass | Pass | Pass | Pass |

Notes:

[1] SCO failure - if the mean number of normal survivors in the test sediment is significantly less (1-tailed t-test at $P \leq 0.10$) than the mean number of normal survivors in the reference sediment and less than 85 percent of the number of normal survivors in the reference sediment.

[2] SCO failure - if the mean growth rate in the test sediment is significantly lower (1-tailed t-test at $P \leq 0.05$) than that in the reference sediment and less than 70 percent of the mean reference sediment response.

[3] SCO failure - if the test sediment mean amphipod mortality is significantly higher (1-tailed t-test at $P<0.05$) than the reference sediment mean amphipod mortality and the absolute mortality is greater than 25 percent.

[4] CSL failure - (single-test criterion) if the mean number of normal survivors in the test sediment is significantly less (1-tailed t-test at $P \leq 0.10$) than the mean number of normal survivors in the reference sediment and less than 70 percent of the mean number of normal survivors in the reference sediment.

[5] CSL failure - (single-test criterion) if the mean individual growth rate in the test sediment is significantly lower (1-tailed t-test at $P \leq 0.05$) than that in the reference sediment and less than 50 percent of the mean reference sediment response.

[6] CSL failure - (single-test criterion) if the test sediment mean amphipod mortality is significantly higher (1-tailed t-test at $P \leq 0.05$) than the reference sediment mean amphipod mortality and the absolute difference is greater than 30 percent.

SCO = Sediment Cleanup Objectives Chapter 173-204 Washington Administrative Code (WAC)

CSL = Cleanup Screening Level

# Table 6

Bioassay Results for the Amphipod *Eohaustorius estuarius* Test

R.G. Haley Site

Bellingham, Washington

| Treatment | Replicate | Initial Number | Number Surviving | Percent Survival | Mean Percent | | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | Survival | Mortality | |
| Control | 1 | 20 | 20 | 100 | 100 | 0 | 0 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |
| Reference (CR22) | 1 | 20 | 19 | 95 | 95 | 5 | 3.5 |
| | 2 | 20 | 19 | 95 | | | |
| | 3 | 20 | 18 | 90 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 19 | 95 | | | |
| SSI-SS-03_0-12 | 1 | 20 | 20 | 100 | 99 | 1 | 2.2 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 19 | 95 | | | |
| | 5 | 20 | 20 | 100 | | | |
| SSI-SS-05_0-12 | 1 | 20 | 20 | 100 | 99 | 1 | 2.2 |
| | 2 | 20 | 19 | 95 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |
| SSI-SS-06_0-12 | 1 | 20 | 19 | 95 | 99 | 1 | 2.2 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |

Notes:

Please refer to laboratory report in Appendix D for additional details.

# Table 7

## Bioassay Results for the Polychaete *Neanthes arenaceodentata* Test

R.G. Haley Site

Bellingham, Washington

| Treatment | Replicate | Initial Number | Number Surviving | Percent Survival | Individual Growth (mg/individual/day) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dry Weight | Mean | Standard Deviation | Ash-free Dry Weight | Mean | Standard Deviaton |
| Control | 1 | 5 | 5 | 100 | 0.785 | 0.902 | 0.1 | 0.485 | 0.577 | 0.083 |
| | 2 | 5 | 5 | 100 | 0.853 | | | 0.626 | | |
| | 3 | 5 | 5 | 100 | 0.859 | | | 0.489 | | |
| | 4 | 5 | 5 | 100 | 1.002 | | | 0.64 | | |
| | 5 | 5 | 5 | 100 | 1.012 | | | 0.646 | | |
| Reference (CR22) | 1 | 5 | 5 | 100 | 0.884 | 0.694 | 0.108 | 0.714 | 0.527 | 0.11 |
| | 2 | 5 | 5 | 100 | 0.621 | | | 0.496 | | |
| | 3 | 5 | 5 | 100 | 0.67 | | | 0.517 | | |
| | 4 | 5 | 5 | 100 | 0.63 | | | 0.483 | | |
| | 5 | 5 | 5 | 100 | 0.665 | | | 0.427 | | |
| SSI-SS-03_0-12 | 1 | 5 | 5 | 100 | 0.698 | 0.843 | 0.116 | 0.585 | 0.687 | 0.115 |
| | 2 | 5 | 5 | 100 | 0.909 | | | 0.703 | | |
| | 3 | 5 | 5 | 100 | 0.86 | | | 0.688 | | |
| | 4 | 5 | 5 | 100 | 0.989 | | | 0.87 | | |
| | 5 | 5 | 5 | 100 | 0.761 | | | 0.592 | | |
| SSI-SS-05_0-12 | 1 | 5 | 5 | 100 | 0.751 | 0.774 | 0.101 | 0.653 | 0.631 | 0.09 |
| | 2 | 5 | 5 | 100 | 0.803 | | | 0.648 | | |
| | 3 | 5 | 5 | 100 | 0.808 | | | 0.662 | | |
| | 4 | 5 | 5 | 100 | 0.89 | | | 0.715 | | |
| | 5 | 5 | 5 | 100 | 0.617 | | | 0.477 | | |
| SSI-SS-06_0-12 | 1 | 5 | 5 | 100 | 0.668 | 0.679 | 0.064 | 0.569 | 0.567 | 0.044 |
| | 2 | 5 | 5 | 100 | 0.626 | | | 0.537 | | |
| | 3 | 5 | 5 | 100 | 0.738 | | | 0.61 | | |
| | 4 | 5 | 5 | 100 | 0.751 | | | 0.61 | | |
| | 5 | 5 | 5 | 100 | 0.61 | | | 0.511 | | |

Notes:

Please refer to laboratory report in Appendix D for additional details.

mg = milligrams

# Table 8

## Bioassay Results for the Bivalve Larvae *Mytilus galloprovincialis* Test

R.G. Haley Site

Bellingham, Washington

| Treatment | Replicate | Number Normal | Number Abnormal | Mean Number Normal (N) | Standard Deviation | Control Normal Survival $N_C/I$ | Reference Normal Survival Relative to Control $N_R/N_C$ | Performance Standard |
|---|---|---|---|---|---|---|---|---|
| **Control** | 1 | 270 | 4 | 273.2 | 19.2 | 97.6 | | >70%; meets criterion |
| | 2 | 242 | 6 | | | | | |
| | 3 | 291 | 5 | | | | | |
| | 4 | 277 | 6 | | | | | |
| | 5 | 286 | 8 | | | | | |
| **Reference (CR22)** | 1 | 206 | 4 | 238.8 | 32 | | 87.4 | >65%; meets criterion |
| | 2 | 256 | 6 | | | | | |
| | 3 | 266 | 2 | | | | | |
| | 4 | 264 | 5 | | | | | |
| | 5 | 202 | 3 | | | | | |
| **SSI-SS-03_0-12** | 1 | 219 | 3 | 229.2 | 32.8 | | | |
| | 2 | 234 | 5 | | | | | |
| | 3 | 183 | 3 | | | | | |
| | 4 | 274 | 1 | | | | | |
| | 5 | 236 | 2 | | | | | |
| **SSI-SS-05_0-12** | 1 | 226 | 2 | 244.6 | 20.7 | | | |
| | 2 | 253 | 3 | | | | | |
| | 3 | 233 | 1 | | | | | |
| | 4 | 234 | 2 | | | | | |
| | 5 | 277 | 2 | | | | | |
| **SSI-SS-06_0-12** | 1 | 246 | 0 | 254 | 24.5 | | | |
| | 2 | 226 | 2 | | | | | |
| | 3 | 288 | 5 | | | | | |
| | 4 | 241 | 3 | | | | | |
| | 5 | 269 | 1 | | | | | |

**Notes:**

I = Mean initial count (stocking density); 280 individuals

$N_C$ = Mean Control Normal

$N_R$ = Mean Reference Normal

Please refer to laboratory report in Appendix D for additional details



Project North

2,000 0 2,000

Feet

Reference: Whatcom County GIS, City of Bellingham GIS, Aerial from Esri, 2013.

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Projection: NAD 1983 UTM Zone 10N

Path: P:\0\0356114\GIS\MXDs\Fig_1-1_VicinityMap.mxd Map Revised: 09 January 2018 maugust

## Vicinity Map

R.G. Haley Site
Bellingham, Washington

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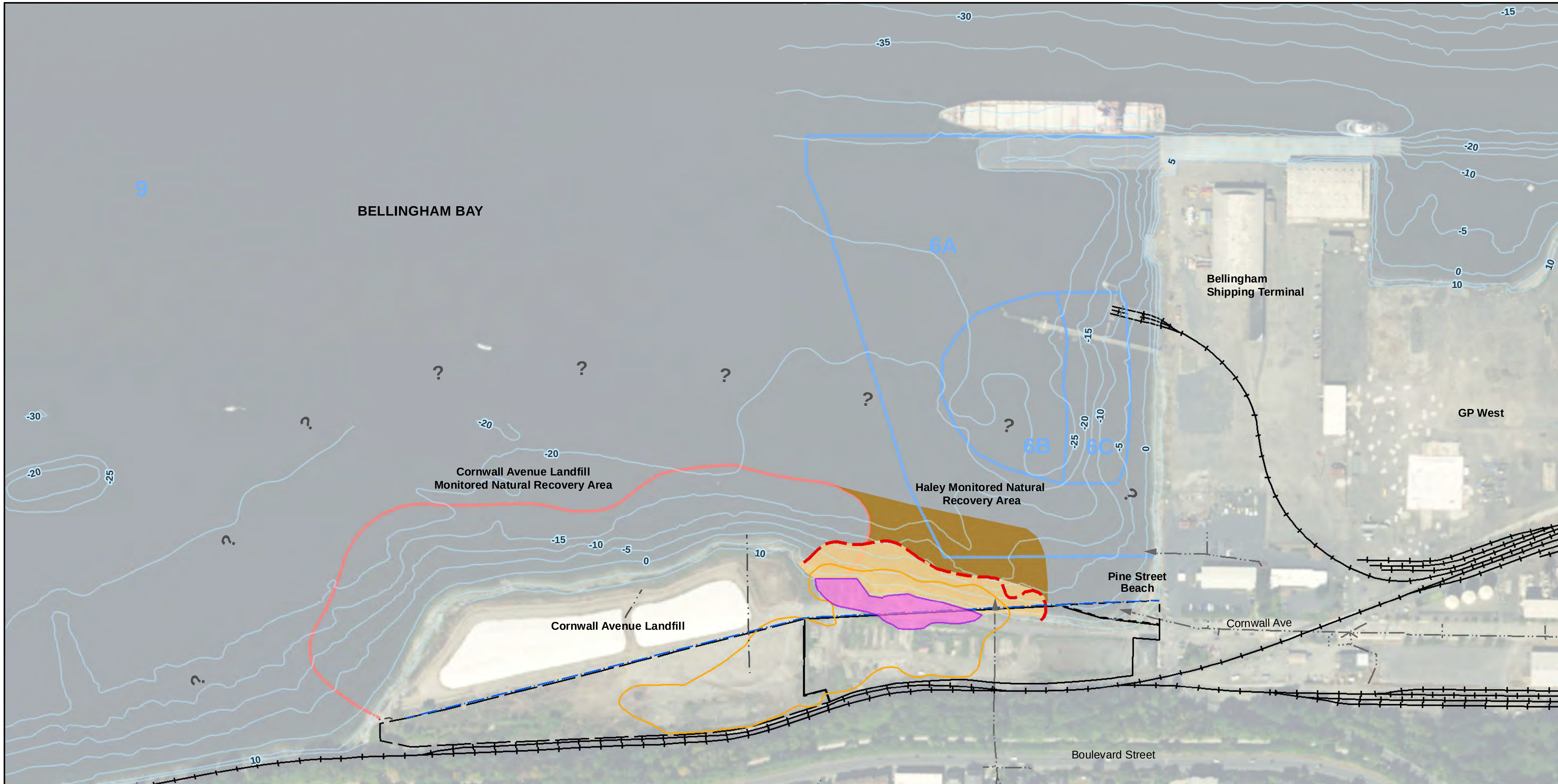
**Figure 1**




True North
Project North

0 150 300
Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

- Storm Drain Pipe
- City Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property
- BNSF Railroad
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units
- Boundary of Haley Sediment SMS Benthic Exceedance
- Boundary of Smear Zone
- Inner Harbor Line
- Potentially Mobile LNAPL at Shoreline
- Excavation, Capping, and Armoring
- Enhanced Natural Recovery

**Preferred Cleanup Action Alternative From the Feasibility Study - Sediment Components**

R.G. Haley Site
Bellingham, Washington

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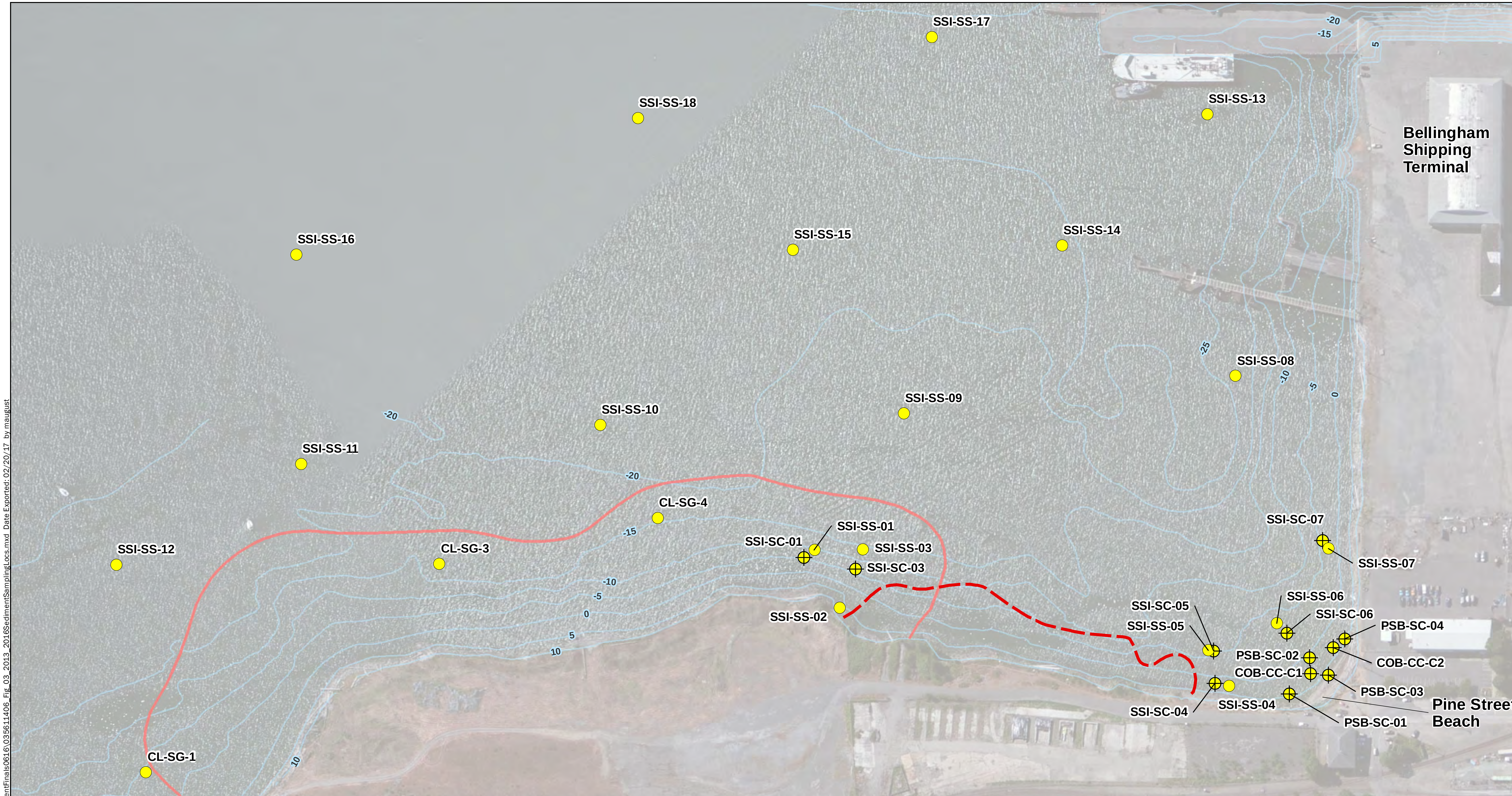
**Figure 2**

Path: \\Wynpz-1\Projects\0\0356114\GIS\MXDs\SedimentFinals0616\035611406_Fig_02_PreferredCleanupActionAltCombined.mxd Map Revised: 20 February 2017 maugust




Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Composite sample locations (COB-CC-C1 and COB-CC-C2) represented as centroid of 3 sample locations.
4. Refer to Table 1 for actual sampling locations.

Data Source: ESRI Data & Maps

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

**Legend**

- Surface Sediment Sample Location
- Subsurface Sediment Sample Location
- Cornwall Landfill Management Unit 2
- Boundary of Haley Sediment SMS Benthic Exceedances

True North
Project North

200 0 200
Feet

**2013-2016 Sediment Sampling Locations**

R.G. Haley Site
Bellingham, Washington

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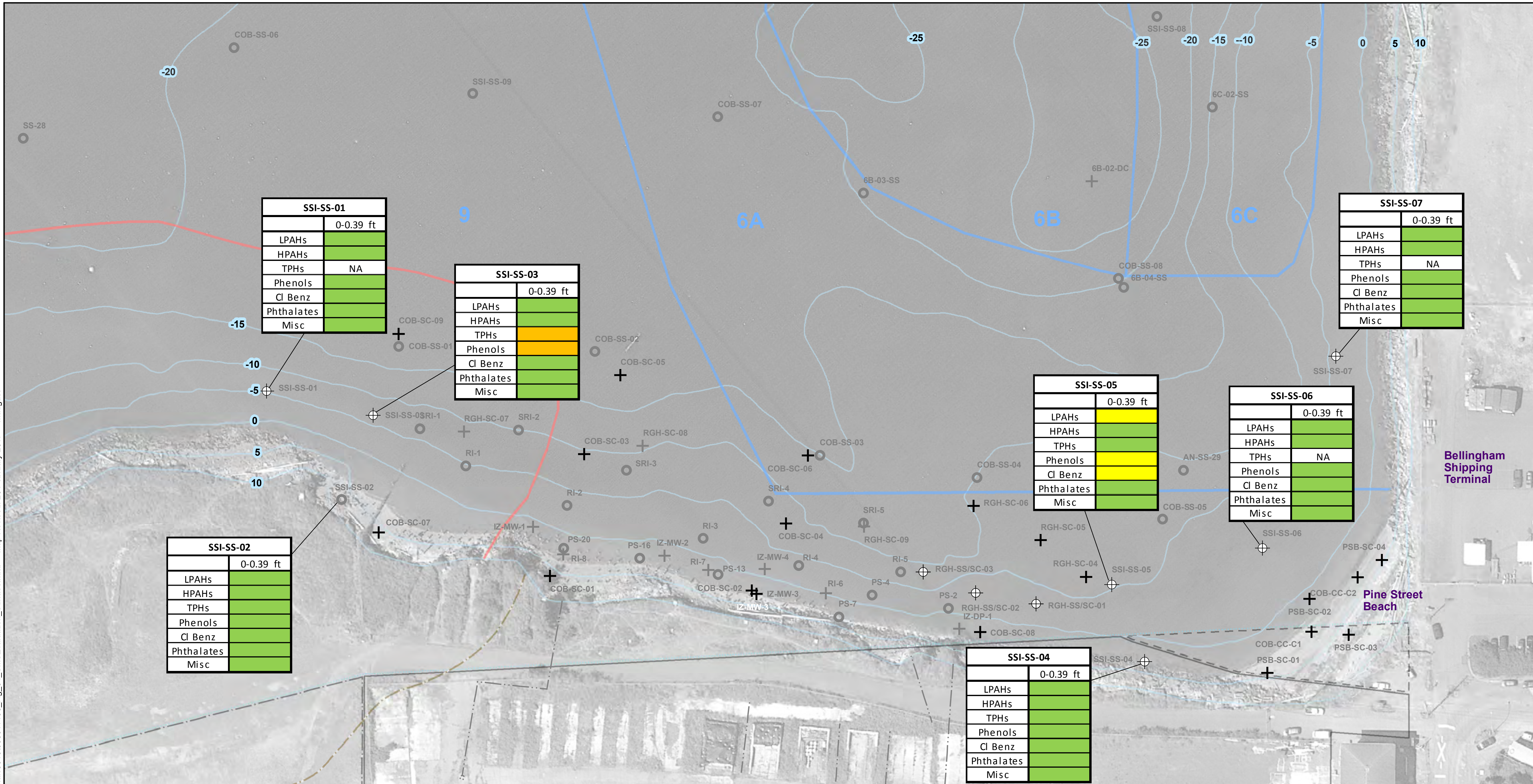
**Figure 3**




Path: \\lynpz-1\Projects\0\0356114\GIS\MXDs\SedimentFinals0616\035611406_Fig_04_SMSEvaluation_Surface.mxd Map Revised: 20 February 2017 maugust

True North
Project North

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. Sample location symbols are gray where not evaluated.

**Legend**

**Supplemental Sediment Investigation Sample Data**

- Exceeds CSL/2LAET Chemical Criterion for One or More Site Contaminants
- Exceeds SCO/LAET Chemical Criterion for One or More Site Contaminants
- Meets SMS Chemical Criteria for Site Contaminants

**Key**

LPAHs = Low molecular weight PAHs
HPAHs = High molecular weight PAHs
TPHs = Total petroleum hydrocarbons
Cl Benz = Chlorinated benzenes
Misc = Miscellaneous organic compounds
NA = Not Analyzed

**SMS Evaluation - Surface Sediment Data**

R.G. Haley Site
Bellingham, Washington

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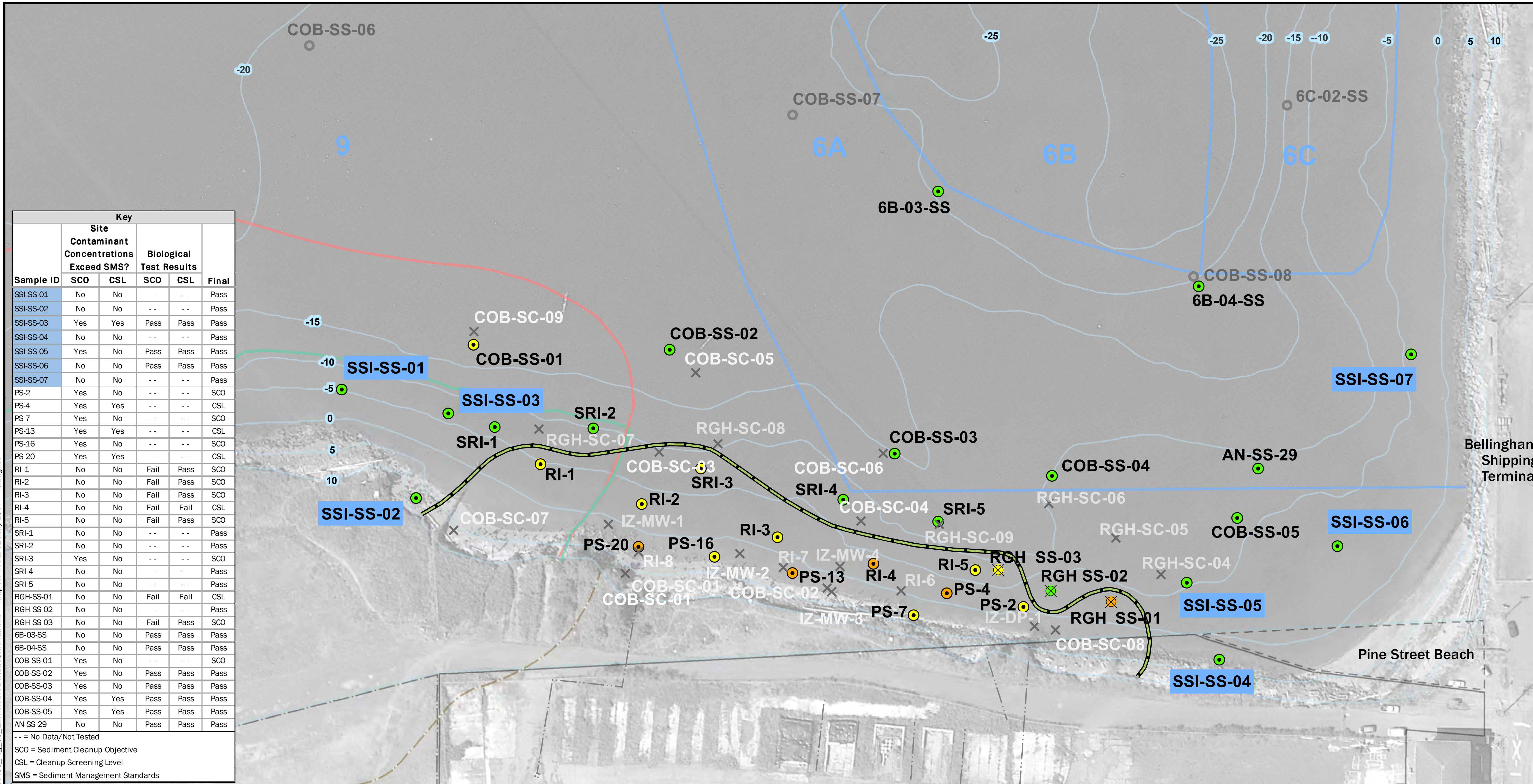
**Figure 4**




| Key | | | | | |
|---|---|---|---|---|---|
| Sample ID | Site Contaminant Concentrations Exceed SMS? SCO | CSL | Biological Test Results SCO | CSL | Final |
| SSI-SS-01 | No | No | - - | - - | Pass |
| SSI-SS-02 | No | No | - - | - - | Pass |
| SSI-SS-03 | Yes | Yes | Pass | Pass | Pass |
| SSI-SS-04 | No | No | - - | - - | Pass |
| SSI-SS-05 | Yes | No | Pass | Pass | Pass |
| SSI-SS-06 | No | No | Pass | Pass | Pass |
| SSI-SS-07 | No | No | - - | - - | Pass |
| PS-2 | Yes | No | - - | - - | SCO |
| PS-4 | Yes | Yes | - - | - - | CSL |
| PS-7 | Yes | No | - - | - - | SCO |
| PS-13 | Yes | Yes | - - | - - | CSL |
| PS-16 | Yes | No | - - | - - | SCO |
| PS-20 | Yes | Yes | - - | - - | CSL |
| RI-1 | No | No | Fail | Pass | SCO |
| RI-2 | No | No | Fail | Pass | SCO |
| RI-3 | No | No | Fail | Pass | SCO |
| RI-4 | No | No | Fail | Fail | CSL |
| RI-5 | No | No | Fail | Pass | SCO |
| SRI-1 | No | No | - - | - - | Pass |
| SRI-2 | No | No | - - | - - | Pass |
| SRI-3 | Yes | No | - - | - - | SCO |
| SRI-4 | No | No | - - | - - | Pass |
| SRI-5 | No | No | - - | - - | Pass |
| RGH-SS-01 | No | No | Fail | Fail | CSL |
| RGH-SS-02 | No | No | - - | - - | Pass |
| RGH-SS-03 | No | No | Fail | Pass | SCO |
| 6B-03-SS | No | No | Pass | Pass | Pass |
| 6B-04-SS | No | No | Pass | Pass | Pass |
| COB-SS-01 | Yes | No | - - | - - | SCO |
| COB-SS-02 | Yes | No | Pass | Pass | Pass |
| COB-SS-03 | Yes | No | Pass | Pass | Pass |
| COB-SS-04 | Yes | Yes | Pass | Pass | Pass |
| COB-SS-05 | Yes | Yes | Pass | Pass | Pass |
| AN-SS-29 | No | No | Pass | Pass | Pass |

- - = No Data/Not Tested
SCO = Sediment Cleanup Objective
CSL = Cleanup Screening Level
SMS = Sediment Management Standards

True North
Project North
0 50 100
Feet

**Sample Type**
Surface Sediment Sample Location
Subsurface Sediment Sample Location
Surface and Subsurface Sediment Sample Location

**Sediment Sample Results**
Exceeds CSL/2LAET Chemical or Biological Criterion for One or More Site Contaminants
Exceeds SCO/LAET Chemical or Biological Criterion for One or More Site Contaminants
Meets SMS Benthic Criteria for Site Contaminants

Estimated boundary of sediment exceedances of SMS benthic chemical and/or toxicity criteria
Supplemental Sediment Investigation Sample Data

[1] Surface = 0-0.39 ft below mudline.

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.

**Extent of SMS Benthic Criteria Exceedances in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

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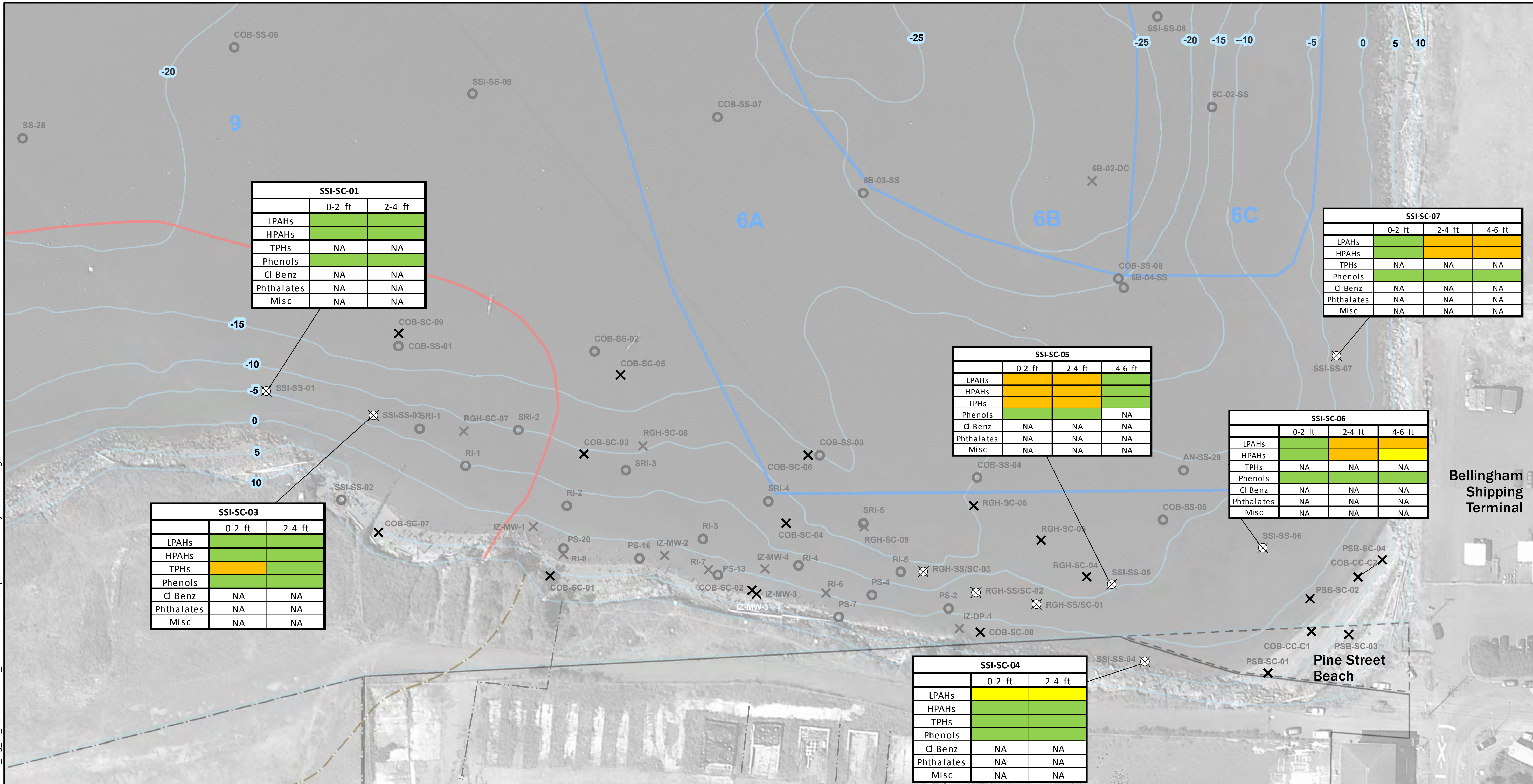
**Figure 5**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\0356114406_Fig_05_ExtentSMSBenthicCriteria.mxd Map Revised: 12 May 2017 maugust




**SSI-SC-01**

| | 0-2 ft | 2-4 ft |
|---|---|---|
| LPAHs | | |
| HPAHs | | |
| TPHs | NA | NA |
| Phenols | | |
| Cl Benz | NA | NA |
| Phthalates | NA | NA |
| Misc | NA | NA |

**SSI-SC-03**

| | 0-2 ft | 2-4 ft |
|---|---|---|
| LPAHs | | |
| HPAHs | | |
| TPHs | | |
| Phenols | | |
| Cl Benz | NA | NA |
| Phthalates | NA | NA |
| Misc | NA | NA |

**SSI-SC-05**

| | 0-2 ft | 2-4 ft | 4-6 ft |
|---|---|---|---|
| LPAHs | | | |
| HPAHs | | | |
| TPHs | | | |
| Phenols | | | NA |
| Cl Benz | NA | NA | NA |
| Phthalates | NA | NA | NA |
| Misc | NA | NA | NA |

**SSI-SC-07**

| | 0-2 ft | 2-4 ft | 4-6 ft |
|---|---|---|---|
| LPAHs | | | |
| HPAHs | | | |
| TPHs | NA | NA | NA |
| Phenols | | | |
| Cl Benz | NA | NA | NA |
| Phthalates | NA | NA | NA |
| Misc | NA | NA | NA |

**SSI-SC-06**

| | 0-2 ft | 2-4 ft | 4-6 ft |
|---|---|---|---|
| LPAHs | | | |
| HPAHs | | | |
| TPHs | NA | NA | NA |
| Phenols | | | |
| Cl Benz | NA | NA | NA |
| Phthalates | NA | NA | NA |
| Misc | NA | NA | NA |

**SSI-SC-04**

| | 0-2 ft | 2-4 ft |
|---|---|---|
| LPAHs | | |
| HPAHs | | |
| TPHs | | |
| Phenols | | |
| Cl Benz | NA | NA |
| Phthalates | NA | NA |
| Misc | NA | NA |

True North

Project North

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016,
Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. Sample location symbols are gray where not evaluated.

## Legend

**Supplemental Sediment Investigation Sample Data**

- Exceeds CSL/2LAET Chemical Criterion for One or More Site Contaminants
- Exceeds SCO/LAET Chemical Criterion for One or More Site Contaminants
- Meets SMS Chemical Criteria for Site Contaminants

**Key**

LPAHs = Low molecular weight PAHs
HPAHs = High molecular weight PAHs
TPHs = Total petroleum hydrocarbons
Cl Benz = Chlorinated benzenes
Misc = Miscellaneous organic compounds
NA = Not analyzed

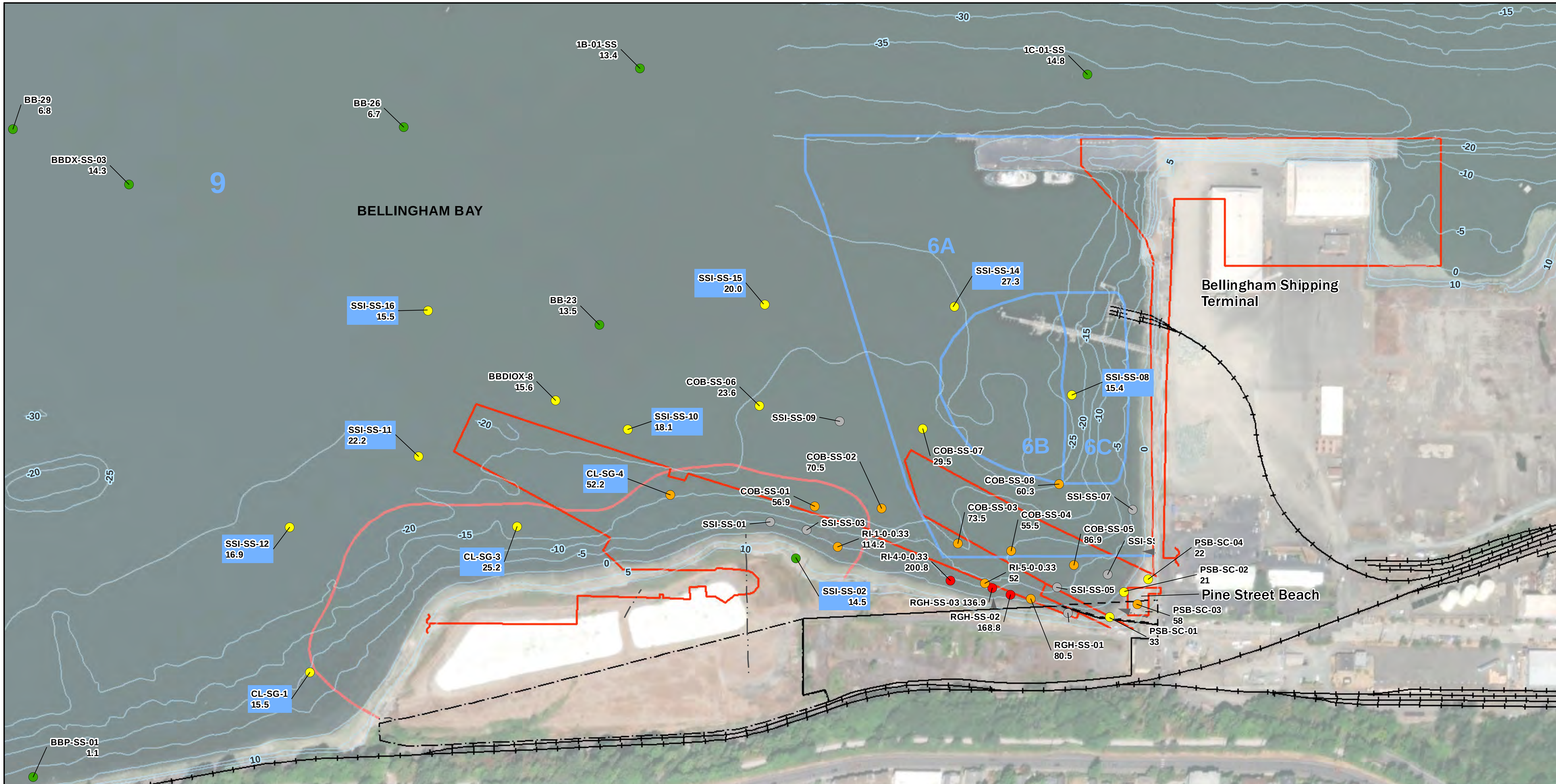
**SMS Evaluation - Subsurface Sediment Data**

R.G. Haley Site
Bellingham, Washington

GeoEngineers

**Figure 6**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\035611406_Fig_06_SMSEvaluation_Subsurface.mxd Map Revised: 12 May 2017 maugust




Path: P:\0035614\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\03561406_Fig_07_DioxinTEQSurfaceSediment.mxd Map Revised: 28 September 2023 maugust

True North
Project North

0 150 300
Feet

**Surface Sediment Dioxin TEQ Concentration (ng/kg)**

- ≤15 (Regional Background)
- >15≤50
- >50≤120
- >120

- Storm Drain Pipe
- City-Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property
- BNSF Railroad
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units
- Contour (5-ft interval)

- Supplemental Sediment Investigation Sample Data
- Footprint of Historic Over-Water Structure

Reference: Aerial from Google Earth, August 2011. Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. Cleanup level = 13 ng/kg TEQ. Regional Background = 15 ng/kg TEQ.
2. The regional background concentration of 15 ng/kg TEQ will be used to characterize the extent of site-related impacts while the cleanup level of 13 ng/kg TEQ will be applied to the area of site-related impacts (see Figure 13).
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

[1]Surface = 0-0.39 ft below mudline (blm) except for sample labels noted by *, which are 0-2 ft blm.

**Dioxin TEQ Concentration in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

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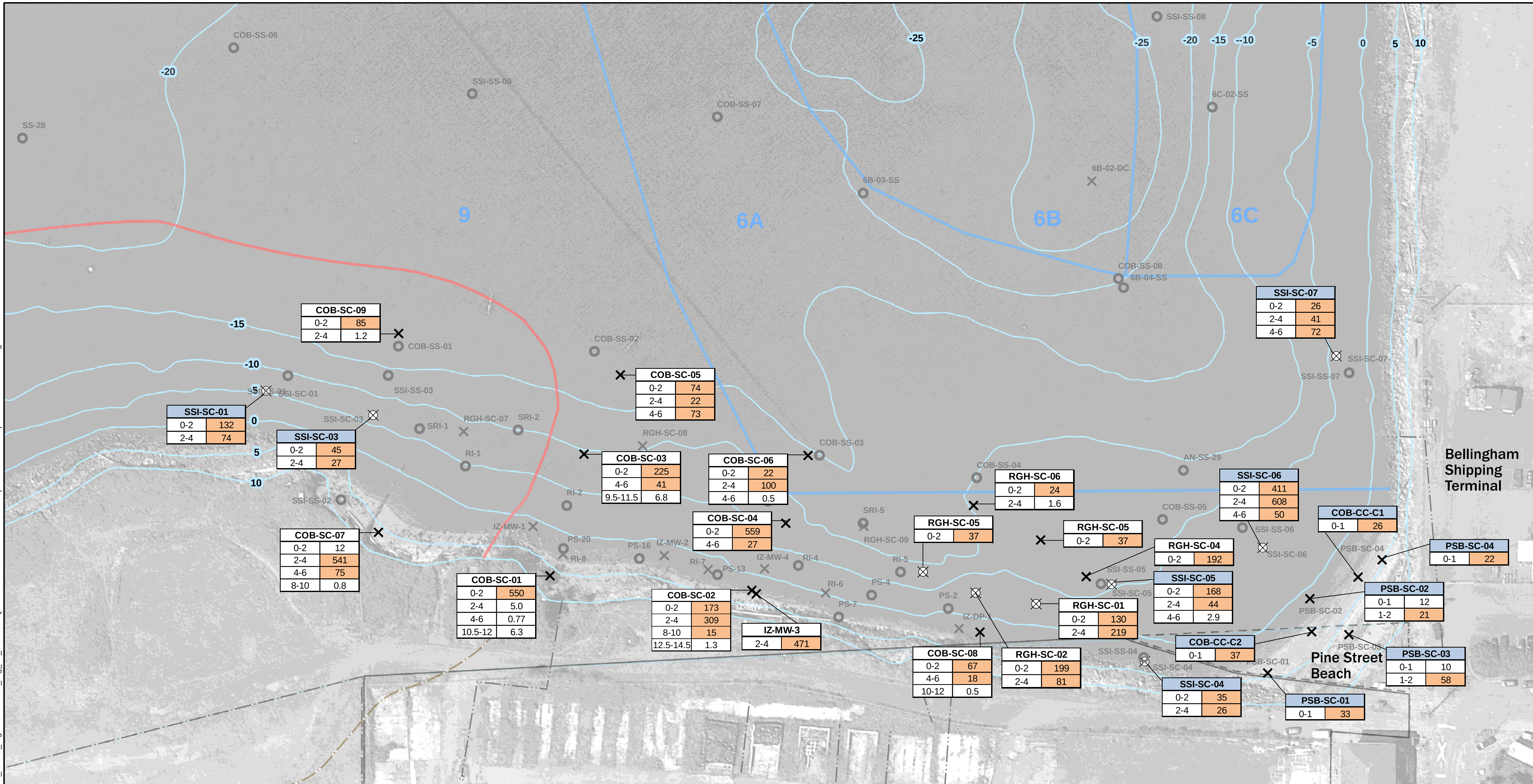
**Figure 7**




**Dioxin TEQ Results**

| Location | |
|---|---|
| Depth below mud line (ft) | Result (ng/kg) |

**Sample Type**

- Surface Sediment Sample Location
- Subsurface Sediment Sample Location
- Surface and Subsurface Sediment Sample Location

- Supplemental Sediment Investigation Sample Data
- Exceeds Cleanup Level (13 ng/kg) TEQ
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. Sample location symbols are gray wherenot evaluated.

**Dioxin TEQ Concentrations in Subsurface Sediment**

R.G. Haley Site
Bellingham, Washington

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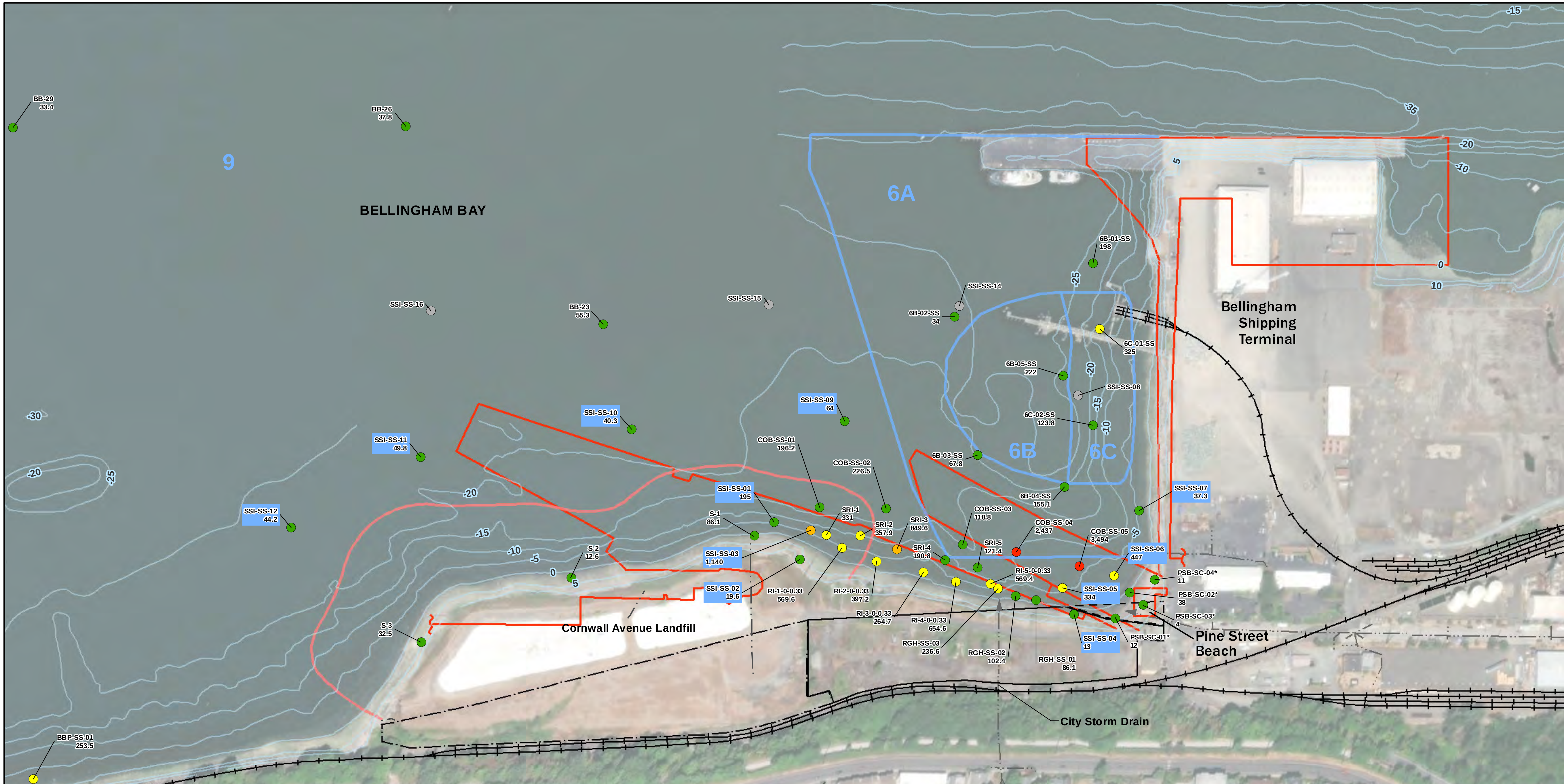
**Figure 8**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\035611406_Fig_08_DioxinTEQSubsurfaceSediment.mxd Map Revised: 29 September 2023 maugust




True North
Project North

0 150 300
Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. Cleanup level = 229 µg/kg TEQ.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Surface Sediment cPAH TEQ Concentration (µg/kg)
- ≤229 (Cleanup Level)
- >229≤800
- >800≤1800
- >1880
- Not Analyzed

- Storm Drain Pipe
- City-Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property
- BNSF Railroad
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units
- Bathymetric Contour (5-ft interval)
- Footprint of Historical Over-Water Structure
- Supplemental Sediment Investigation Sample Data

[1]Surface = 0-0.39 ft below mudline (blm) except for sample labels noted by *, which are 0-2 ft blm.

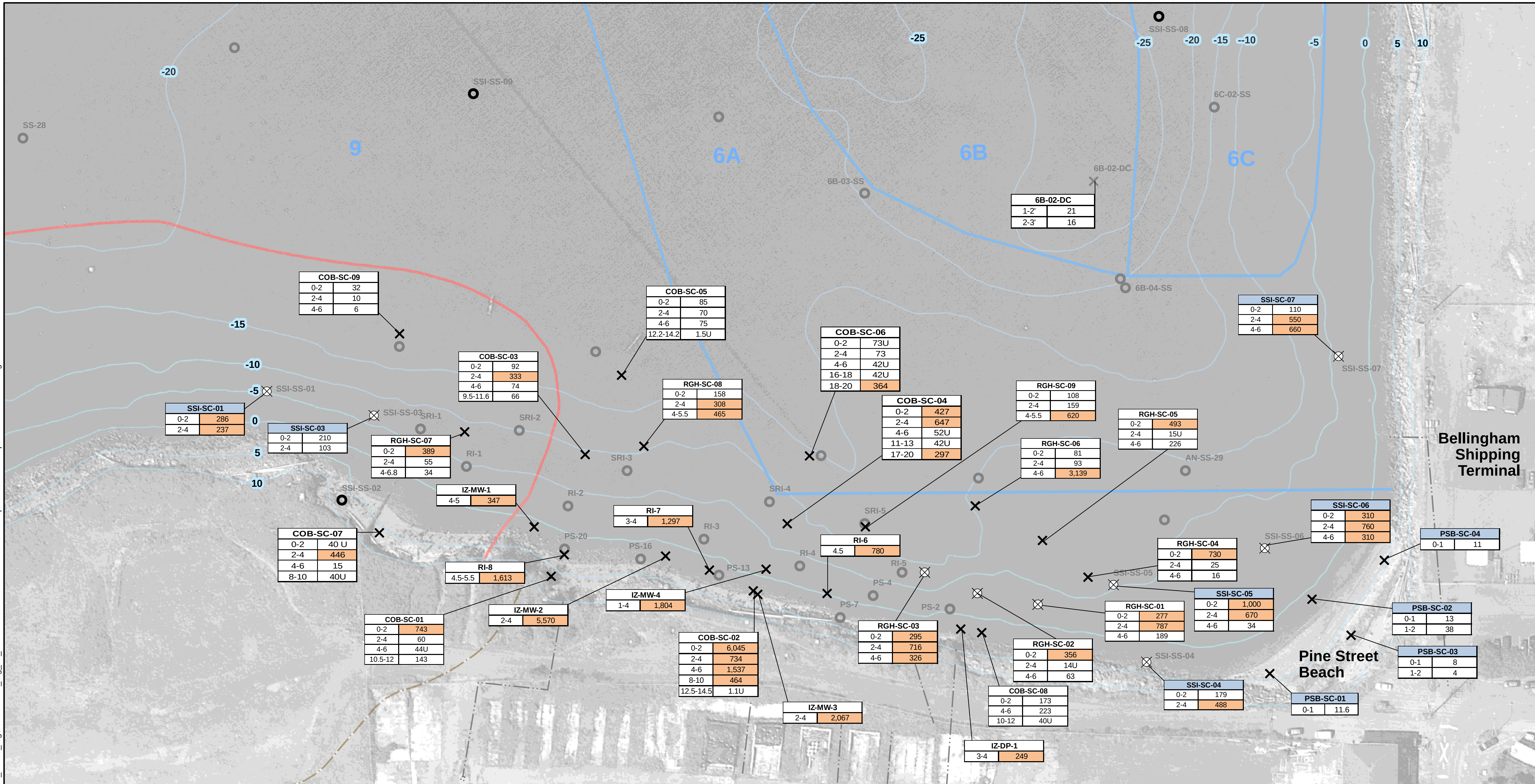
**cPAH TEQ Concentrations in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

GeoEngineers

**Figure 9**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\035611406_Fig_09_cPAHSurfaceSediment.mxd Map Revised: 28 September 2023 maugust




W True North
S N Project North
E

0 50 100
Feet

**cPAH TEQ Results**

| Location | |
|---|---|
| Depth below mud line (ft) | Concentration (µg/kg) |

Concentrations are expressed as the toxic equivalent (TEQ) of benzo(a)pyrene

**Sample Type**

- Surface Sediment Sample Location
- Subsurface Sediment Sample Location
- Surface and Subsurface Sediment Sample Location
- Supplemental Sediment Investigation Sample Data
- Exceeds Cleanup Level (229 µg/kg TEQ)
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. Sample location symbols are gray where tests not performed.
4. Reported values rounded for presentation.

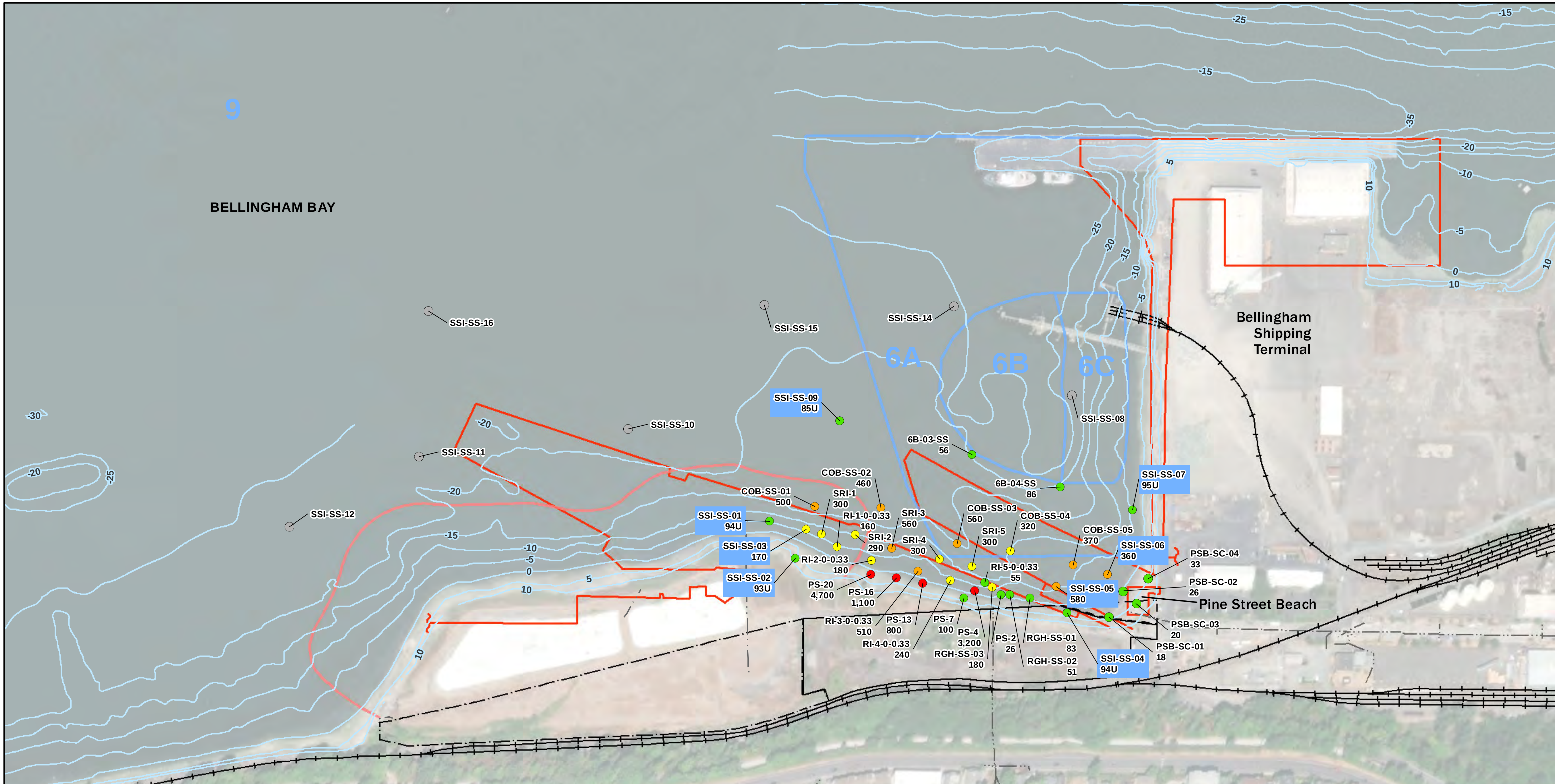
Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\035611406_Fig_10_cPAHSubsurfaceSediment.mxd Map Revised: 28 September 2023 maugust

**cPAH TEQ Concentrations in Subsurface Sediment**

R.G. Haley Site
Bellingham, Washington

GEOENGINEERS

**Figure 10**




W
True North
S
N
E
Project North

0 150 300
Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum. Cornwall Landfill Site boundary, Landau 2016, Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. Cleanup level = 100 µg/kg.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. U = chemical not detected at identified detection limit.

**Surface Sediment Concentration (µg/kg)**

- ≤100 (Cleanup Level)
- >100≤350
- >350≤790
- >790
- Not Analyzed

- Storm Drain Pipe
- City-Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property
- BNSF Railroad
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units
- Bathymetric Contour (5-ft interval)

- Supplemental Sediment Investigation Sample Data
- Footprint of Historic Over-Water Structure

[1]Surface = 0-0.39 ft below mudline (blm) except for sample labels noted by *, which are 0-2 ft blm.

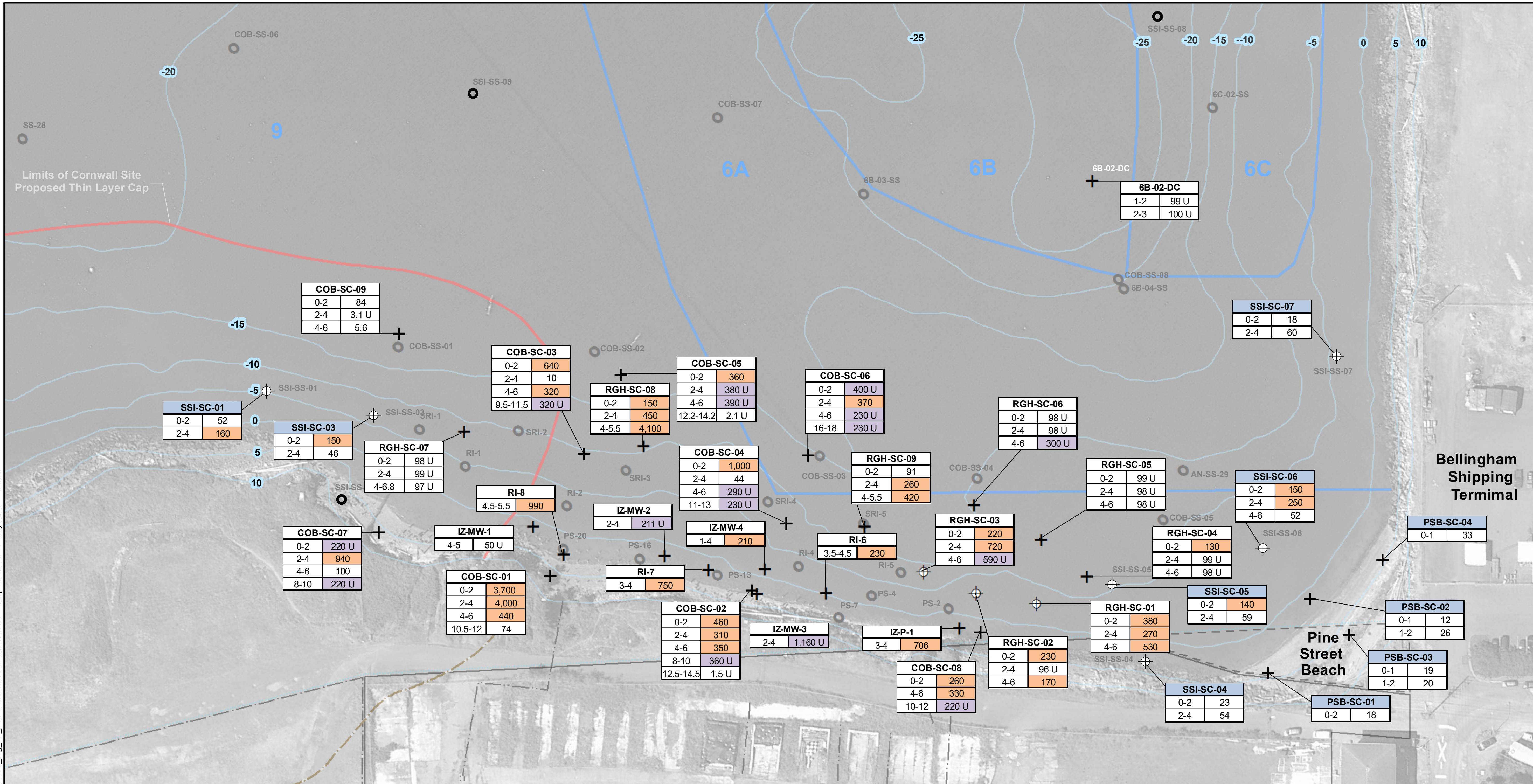
**Pentachlorophenol Concentrations in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

GeoEngineers

**Figure 11**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\035611406_Fig_11_PCPSurfaceSediment.mxd Map Revised: 30 October 2023 maugust




Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\0356114-06_Fig_12_PCPSubsurfaceSediment.mxd    Map Revised: 17 May 2017    tkauhi

Project North / True North

0 50 100
Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.
Cornwall Landfill Site boundary, Landau 2016,
Whatcom Waterway Site Unit boundaries, Anchor QEA 2015.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. Sample location symbols are grey where tests not performed.
4. U = chemical not detected at identified detection limit.
5. Reported values rounded for presentation.

**Pentachlorophenol Results**

| Location | |
|---|---|
| Depth below mud line (ft) | Result (µg/kg) |

**Sample Type**

- Surface Sediment Sample Location
- Subsurface Sediment Sample Location
- Surface and Subsurface Sediment Sample Location

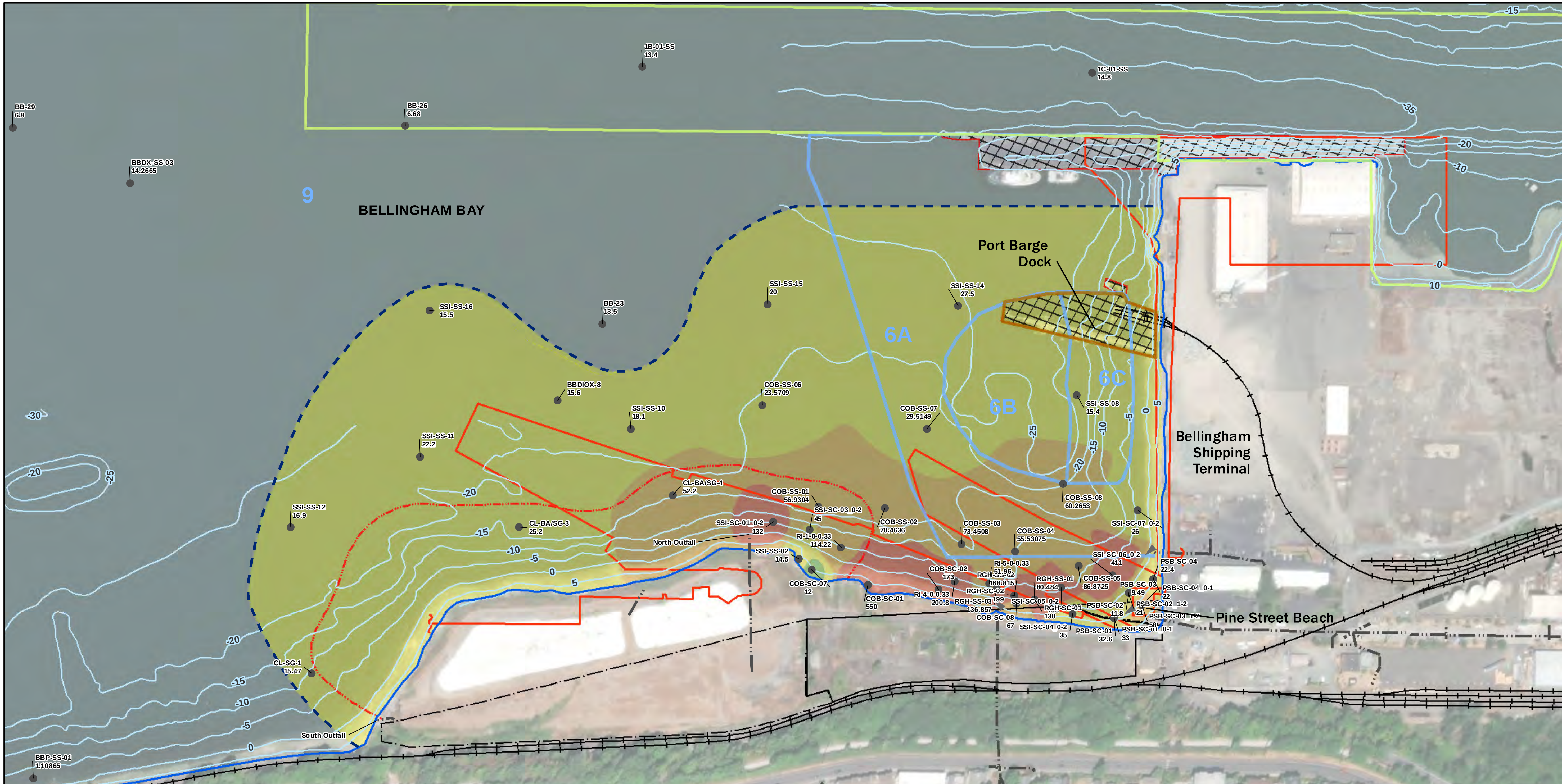
- Supplemental Sediment Investigation Sample Data
- Exceeds Cleanup Level (100 µg/kg)
- Not Detected. DL > Cleanup Level
- Cornwall Landfill Management Unit 2
- Whatcom Waterway Monitored Natural Recovery Site Units

**Pentachlorophenol Concentrations in Subsurface Sediment**

R.G. Haley Site
Bellingham, Washington

GEOENGINEERS

**Figure 12**




True North

Project North

0 150 300

Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. Cleanup level = 13 ng/kg TEQ. Regional Background = 15 ng/kg TEQ.
2. Interpolations settings: IDW Power=6, Neighbors=8, Reach=600ft.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

**Surface Sediment Dioxin TEQ Concentration (ng/kg)**

- ≤13 (Cleanup Level)
- >13≤45
- >45≤120
- >120

Estimated Extent of Regional Background Exceedance

**Current**

- Storm Drain Pipe
- BNSF Railroad
- Present-day Over-water Structure
- Current Shoreline
- Bathymetric Contour (5-ft interval)

**Property Lines**

- City-Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property

**Proposed Remedies**

- Proposed Cornwall Avenue Landfill Sediment Remedy
- Whatcom Waterway Monitored Natural Recovery Site Units
- Whatcom Waterway Dredging or Capping Site Units
- Whatcom Waterway Capping with Armoring
- Footprint of Historical Over-Water Structure

[1]Surface = 0-0.39 ft below mudline (blm), except for sample labels noted by *, which are 0-2 ft blm.

**Interpolated Extent of Dioxin/Furan TEQ in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

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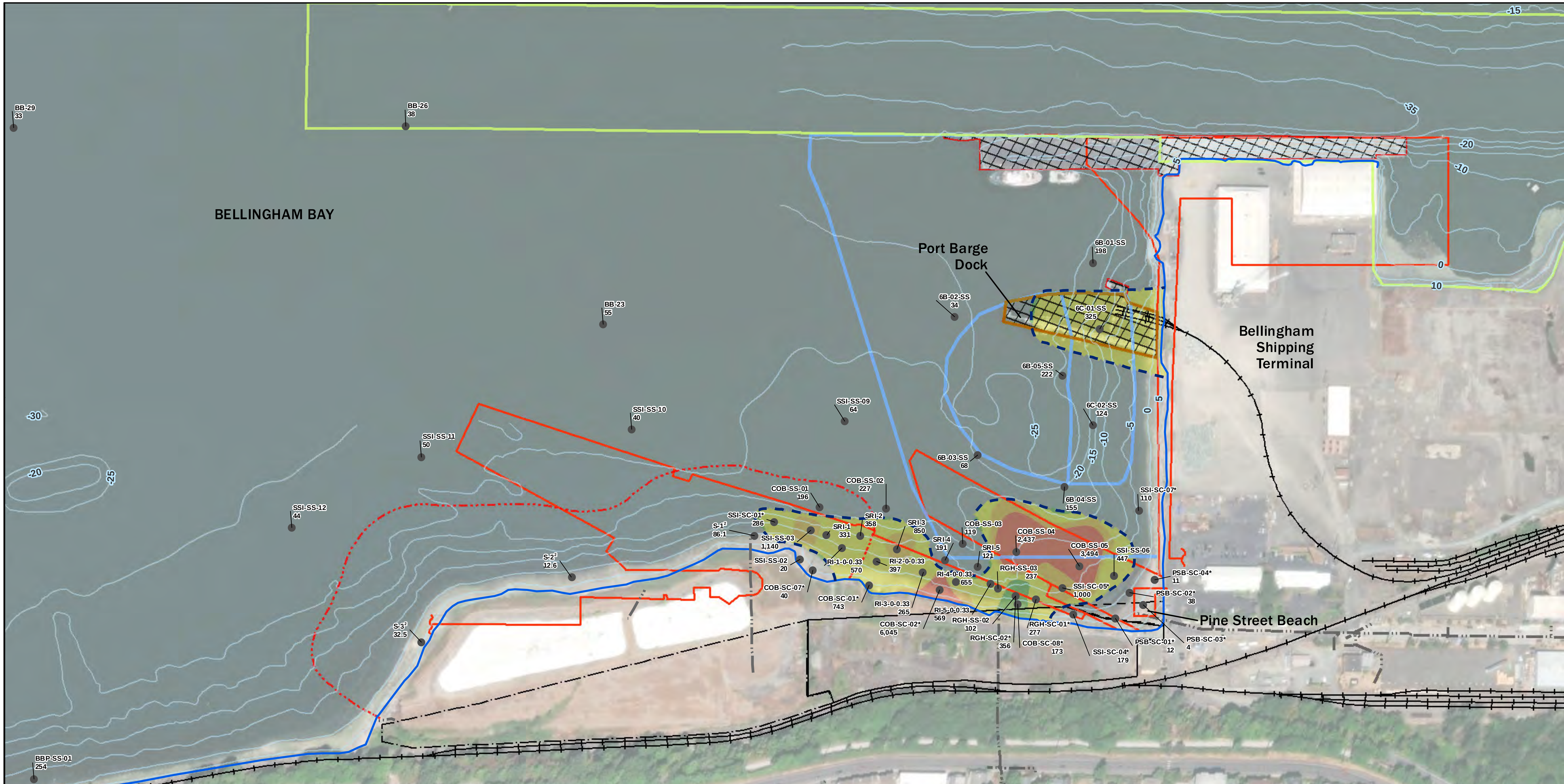
Figure 13

Path: P:\0035611\4\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\035611406_Fig_13_DioxinFuranInterpolation_CAP.mxd Map Revised: 29 September 2023 maugust

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\092523_edited_Figs\035611406_Fig_14_cPAH.mxd Map Revised: 30 October 2023 maugust




Surface Sediment cPAH TEQ Concentration (µg/kg)
- ≤229 ( Cleanup Level)
- >229 ≤ 800
- >800 ≤ 1800
- >1800

Estimated Extent of Cleanup Level Exceedance

**Current**
- Storm Drain Pipe
- BNSF Railroad
- Present-day Over-water Structure
- Current Shoreline
- Contour (5-ft interval)

**Property Lines**
- City-Owned Property, Former R.G. Haley International
- Cornwall Property
- Port of Bellingham Property

**Proposed Remedies**
- Proposed Cornwall Avenue Landfill Sediment Remedy
- Whatcom Waterway Monitored Natural Recovery Site Units
- Whatcom Waterway Capping with Armoring
- Whatcom Waterway Dredging or Capping Site Units
- Footprint of Historic Over-Water Structure

Project North / True North
0 150 300 Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. Cleanup level = 229 µg/kg TEQ.
2. Interpolation settings: IDW Power=6, Neighbors=8, Reach=600ft.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

[1]Surface = 0-0.39 ft below mudline (blm), except for sample labels noted by *, which are 0-2 ft blm.

[2]The cPAH TEQ for this sample excludes dibenz (a,h) anthracene because a concentration for this compound was not reported.

**Interpolated Extent of cPAH TEQ in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

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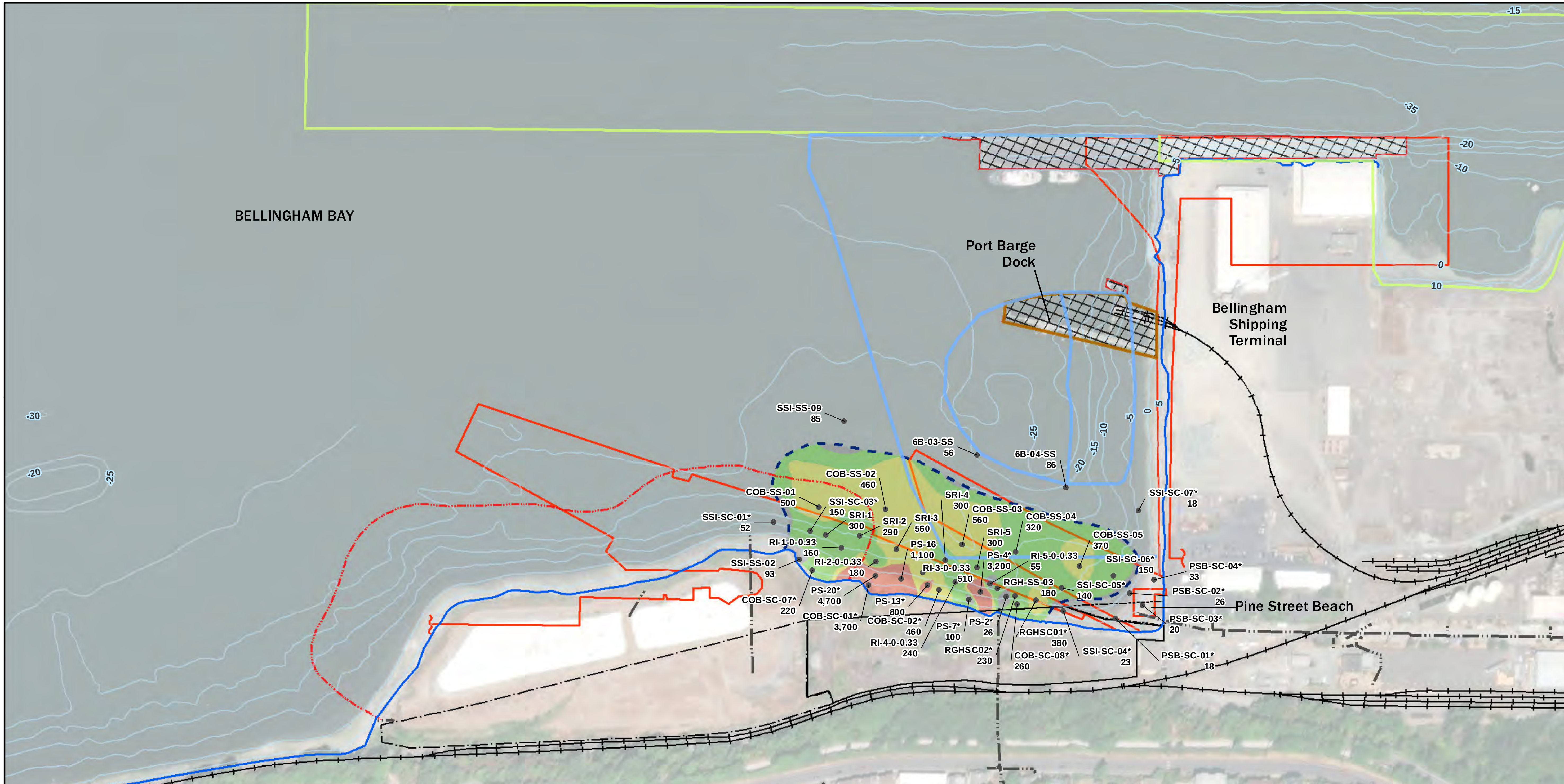
Figure 14




Surface Sediment Pentachlorophenol Concentration (µg/kg)
- ≤100 (Cleanup Level)
- >100≤350
- >350≤790
- >790

Estimated Extent of Cleanup Level Exceedance

**Current**
- Storm Drain Pipe
- BNSF Railroad
- Present-day Over-water Structure
- Current Shoreline
- Contour (5-ft interval)

**Property Lines**
- City-Owned Property, Former R.G. Haley
- Cornwall Property
- Port of Bellingham Property

**Proposed Remedies**
- Proposed Cornwall Avenue Landfill Sediment Remedy
- Whatcom Waterway Monitored Natural Recovery Site Units
- Whatcom Waterway Capping with Armoring
- Whatcom Waterway Dredging or Capping Site Units
- Footprint of Historic Over-Water Structure

True North
Project North

0 150 300
Feet

[1]Surface = 0-0.39 ft below mudline (blm), except for sample labels noted by *, which are 0-2 ft blm.

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. Cleanup level = 100 µg/kg.
2. Interpolations settings: IDW Power=6, Neighbors=8, Reach=600ft.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

**Interpolated Extent of Pentachlorophenol in Surface[1] Sediment**

R.G. Haley Site
Bellingham, Washington

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**Figure 15**

Path: P:\0\0356114\GIS\MXDs\SedimentFinals0616\035611406_Fig_15_PCPInterpolation_new.mxd Map Revised: 30 October 2023 maugust

# APPENDIX A
## Field Logs and Forms

# A.1 Pine Street Beach
# Field Forms - 2013

Site: RG Haley

Date: 8/17/13

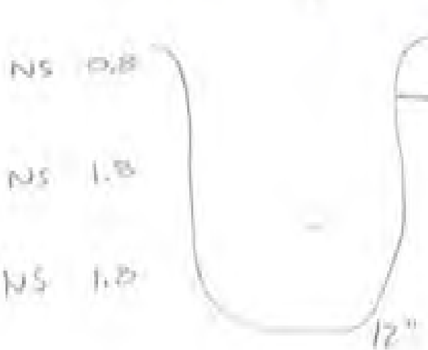
Loc: COB-CC-D1

Weather: Cloudy, 60s

Time: 0740

Tide: High: 8.45' @ 12:44 am Low: -0.98 @ 8:39 am Datum: MLLW, NOAA
Cherry Point
ID 9449424

Sample Description




Light gray f-c SAND occ gravel and shell hash, tr glass fragments, brick frag, and organics (seaweed and small twigs) (loose, moist)

Gray f-c SAND occ gravel tr shell hash, brick frag, glass frag

Odor: None

Sheen: NS

PID: 0.8-1.8

Live Organisms: None

Site: RG Haley

Weather: See D1

Date: 8/17/13

Time: 08:05

Loc: COB-CC-D2

Tide: High: See D1 Low: Datum:

Sample Description

| Sheen | PID |
| --- | --- |
| NS | 0.8 |
| NS | 1.1 |

0"

Gray fc SAND occ gravel to shell hash, glass frag., brick frag

12"

Odor: None

Sheen: NS

PID: ~~0.1~~ 0.8-1.1

Live Organisms: None

Site: RG Haley

Date: 8/17/13

Loc: COB-CC-D3

Weather: See D1

Time: 0820

Tide: High: See D1 Low: Datum:

Sample Description

Dark gray f-c SAND w/silt, gravel, tr shell hash, tr glass frag, brick frag

ex hole 12"

Odor: v slight sulfur

Sheen: NS

PID: 4.2

Live organisms: None

Site: RG Haley

Weather: See D1

Date: 8/17/13

Time: 0945

Loc: COB-CC-D4

Tide: High: See D1 Low: Datum:

Sample Description

| PID | Sheen |
|---|---|
| 1.0 | NS |
| 1.0 | NS |

0" ← removed 2" wood/soil layer

2"

Brown f-m SAND tr shell hash, brick frag, glass frag, org (tr woody mat'l) (loose, moist)

14"

Odor: None

Sheen: NS

PID: 1.0

Live organisms: None

Site: RG Haley

Weather: See D1

Date: 8/17/13

Time: 0925

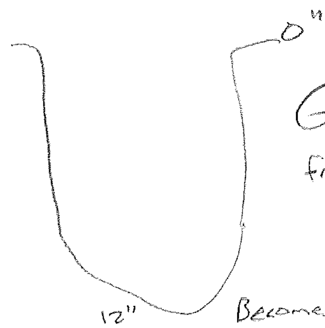
Loc: COB-CC-D5

Tide: High: See D1 Low: Datum:

Sample Description

NS 1.1

NS 1.7




Gray f-m SAND and shell hash, occ gravel, tr glass and brick frag, tr wood (tr sawdust, ~0.25" lens in N sidewall)

Becomes wet @ 12", one live clam @ 4", one live clam @ 12"

Odor : None

Sheen: NS

PID: 1.1-1.7

Live Org: 2 live clams

Site: RG Haley

Weather: See D1

Date: 8/17/13

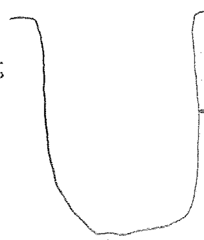
Time: 0855

Loc: COB-CC-D6

Tide: High: See D1 Low: Datum:

Sample Description

| PID | Sheen | | |
|---|---|---|---|
| 1.8 | NS | 0" | 6" Gray Fm SAND w/silt occ gravel, tr shell hash, one lg brick frag, tr glass frag |
| 1.7 | NS | | 6" SAA, darker gray |
| | | 12" | |



Odor: slight sulfur

Sheen: NS

PID: 1.7-1.8

Live Org: Live clams
One large centipede-like org (see pic)
Several small worms

# A.2 Supplemental Sediment Investigation Field Forms - 2015

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* Sunny, Warm

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Teton

*Sampling Crew:* Mike, Chad, Paul, Claudia

*Sampling Method:* Power Grab

*Sample Location:* SS1-SS-01

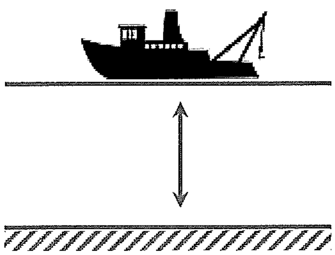
*Target Depth (ft):* 12cm

***Target Coordinates:***

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* 8.3'

*Time:* 1231

*Mudline Elevation:*

*Datum:*

***Acceptance Criteria:***

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | — | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): Mostly brick, glass, rock and clam

Other Debris (describe):

See back for additional attempts

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

SSI-SS-01 10/15/15

Attempt 1 Brick, glass, rock + clam
Attempt 2 low volume, brick, glass, ~~glass~~ tile
" 3 rock, brick
" 4. rock, clam, brick
" 5 two big rocks (4" approx. diam)
" 6 two more big rocks (4" to 6" diam)
" 7 brick, large rock
" 8 brick, rocks, clam

rejected

All rejected. above
Relocated Approx 10 feet

Attemp 9 9cm of penetration. — COMPOSITE
" 10 insufficient volume, rocks in jaws — rejected
" 11 6cm of penetration — COMPOSITE
" 12 clams, rocks, washed out — rejected
" 13 8cm penetration — COMPOSITE
" 14 Tile back splash (8" long) — rejected
" 15 4cm penetration — COMPOSITE

## SEDIMENT SAMPLING FORM—SURFACE GRABS

Project: R.G. Haley Supplemental Sediment Investigation

Date: 10/15/15

Project No.: 0356-114-06

Weather: Sunny, warm

Subcontractor: Gravity Environmental LLC

Vessel: Teton

Sampling Crew:

Sampling Method: Power Grab

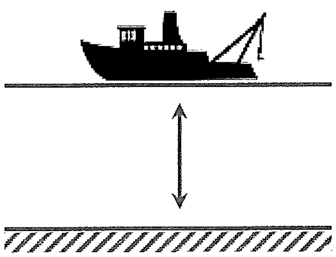
Sample Location: SS1-SS-01

Target Depth (ft): 12 cm

Target Coordinates:

Long/Easting:
(See navigation report for actual)

Lat/Northing:



Water Elevation:

Datum:

Depth to Mudline: 9.5'

Time: 1246

Mudline Elevation:

Datum:

Acceptance Criteria:

- Overlying water present
- Low turbidity in overlying water
- Grab not over-filled
- Sediment surface ~flat
- No winnowing/washout
- Target penetration achieved

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 9 | 9 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

approx 1" rocks

Shell hash (circle): Present Absent

Shell fragments
whole shells

Vegetation/Biota (describe):

→ Grab #9
#11
#13
#15
#18

Other Debris (describe):

Glass

see attempt #11 notes

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None.

RPD depth (cm): 0

See notes on back →

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): very Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

PID = 0 ppm

Logged by:

Page 1 of 2

10/15/15

# SS1-SS-01

| | | | |
|---|---|---|---|
| Attempt | 16 | Rock in jaw, washed out | Rejected |
| | 17 | " | " |
| | 18 | 6 cm penetration | COMPOSITE |

— DONE —

Samples collected SS1-SS-01_0-12
SS1-SS-DUP-03

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* Sunny, warm

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Treton

*Sampling Crew:*

*Sampling Method:* Power Grab

*Sample Location:* SSI-SS-01

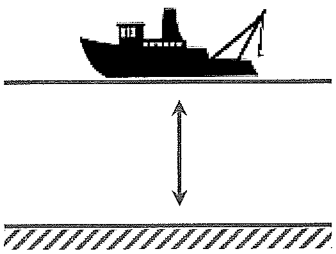
*Target Depth (ft):* 12cm

***Target Coordinates:***

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:*** 9.5'

***Time:*** 12:59

***Mudline Elevation:***

***Datum:***

***Acceptance Criteria:***

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 11 | 6 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only— fine to med Gravel with fine to coarse Sand

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Whole clams

Other Debris (describe):

glass

Grab # 9
#11
#13
#15
#18

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None

RPD depth (cm): 0

One composite sample

Sediment Odor Type (circle): None Petroleum $H_2S$

SSI-SS-01_0-12
and
SSI-SS-DUP-03

Odor Strength (circle): very Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: SSI-SS-01_0-12 4 jars to ARI + 1 2-gal bucket for bioassay

PID = 0ppm SSI-SS-DUP-03 4 jars to ARI

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* Sunny, warm

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:*

*Sampling Method:* Power Grab

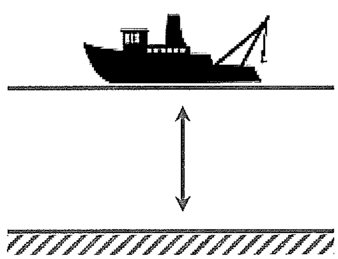
*Sample Location:* SS1-SS-01

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:*** 9.5'

***Time:*** 1305

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 13 | 6 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only— fine to coarse gravel w/ fine to coarse sand and silt

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% roots

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Shells, worms

Other Debris (describe):

Glass,

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None, too coarse

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong NA

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

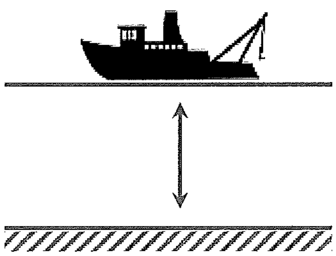
*Sample Location:* SSI-SS-01

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* 9.5'

*Time:* 1310

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 15 | 4 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only— fine to ~~med~~ coarse gravel w/ fine to coarse sand and silt

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Shells, Clams

Other Debris (describe):

Glass

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None, too coarse

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong NA

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/18

*Project No.: 0356-114-06*

*Weather:* Sunny, warm

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Triton

*Sampling Crew:*

*Sampling Method:* Power Grab

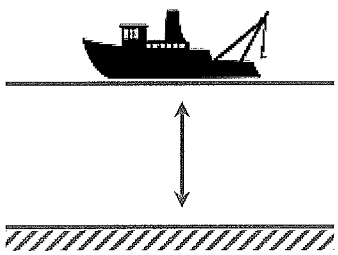
*Sample Location:* SSI-SS-01

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* 9.5'

*Time:* 1315

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 18 | 6cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

fine to coarse gravel w/ fine to coarse sand → see attempt 11 noted

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Shells, Clams

Other Debris (describe):

Glass

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None, too coarse

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong N/A

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* lt rain, hi 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* R, GL, CV

*Sampling Method:* Power grab

*Sample Location:* SS1-SS-01

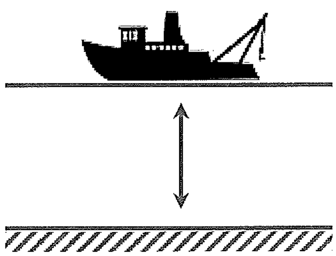
*Target Depth* ~~*(ft)*~~*:* 12 cm

*Target Coordinates:*

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~3'

*Datum:* NAVD88

*Depth to Mudline:* 4.4'

*Time:* 11:04

*Mudline Elevation:* -1.4

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 0 | Yes No | ~~Discrete~~ or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): gravel and cobbles

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by: GRL

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

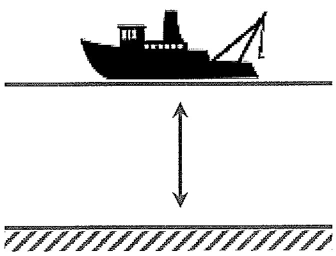
*Sample Location:* ~~SS-1-~~ SS1-SS-01

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:**

**Datum:**

**Depth to Mudline:**

**Time:**

**Mudline Elevation:**

**Datum:**

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): cobble, mussels. Moved ~5' offshore for next attempt

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by: GRL

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

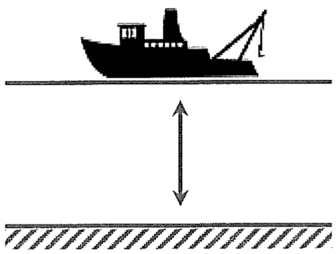
*Sample Location:* SS1-SS-01

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* 5.8'

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobbles, gravel

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

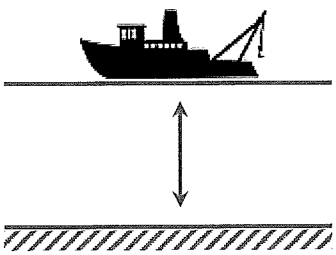
*Sample Location:* SS1-SS-01

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:*** 6.5'

***Time:***

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 4 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Contains one cobble in jaws

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* *Date:* 10/12

*Project No.: 0356-114-06* *Weather:*

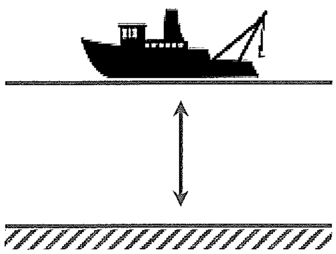
*Subcontractor: Gravity Environmental LLC* *Vessel:*

*Sampling Crew:* *Sampling Method:*

*Sample Location:* SS1-SS-01 *Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:* *Lat/Northing:*
*(See navigation report for actual)*



***Water Elevation:***

***Datum:***

***Depth to Mudline:***

***Time:***

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 5 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobbles, a few ~~clams~~ clams

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/12

*Project No.: 0356-114-06* ____________ | *Weather:* ____________

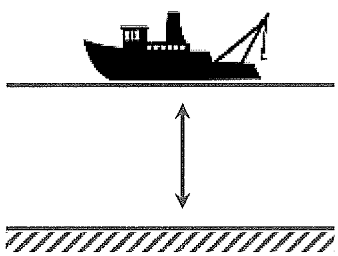
*Subcontractor: Gravity Environmental LLC* ____________ | *Vessel:* ____________

*Sampling Crew:* ____________ | *Sampling Method:* ____________

*Sample Location:* SS1-SS-01 | *Target Depth (ft):* ____________

*Target Coordinates:*

*Long/Easting:* ____________ | *Lat/Northing:* ____________
*(See navigation report for actual)*



*Water Elevation:* ____________

*Datum:* ____________

*Depth to Mudline:* ____________

*Time:* ____________

*Mudline Elevation:* ____________

*Datum:* ____________

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 6 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobbles

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* — Date: 10/15/15

*Project No.: 0356-114-06* — Weather: overcast, cool

*Subcontractor: Gravity Environmental LLC* — Vessel: N/A sampled @ low tide

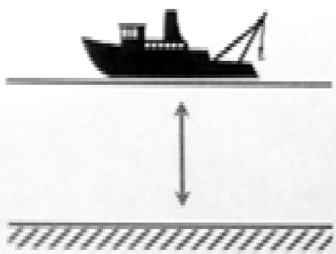
Sampling Crew: Pearl — Sampling Method: by hand, spoon

Sample Location: SSI-SS-02 — Target Depth (ft): 4-5"

Target Coordinates: -122.49356

Long/Easting: ~~-122.49076~~ — Lat/Northing: 48.74082 ~~48.74411~~

(See navigation report for actual)



**Water Elevation:** ~~[illegible]~~ 4.0

**Datum:** MLLW

**Depth to Mudline:** 0

**Time:** ~~2230~~ 2200

**Mudline Elevation:**

**Datum:**

*Acceptance Criteria:*

- Overlying water present
- Low turbidity in overlying water
- Grab not over-filled
- Sediment surface ~flat
- No winnowing/washout
- Target penetration achieved

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 12 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay w/F-M Sa

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): None

Other Debris (describe): glass, tiles, brick fragments

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): none, shell hash to 5"

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$ slight

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: PID = 0.0

Logged by: PDR

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

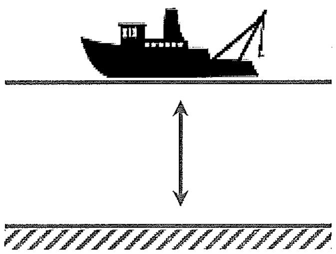
*Sample Location:* SS1-SS-03

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~~3~~ 2.87

*Datum:* NAVD88

*Depth to Mudline:* 3.6

*Time:* 11:46

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): f-c GRAVEL

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

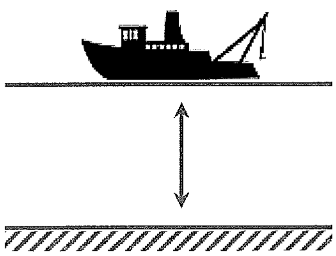
*Sample Location:* SS1-SS-03

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobble; slight sheen on water surface after grab. Dissipates after one minute.

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/12/15

*Project No.: 0356-114-06* | *Weather:*

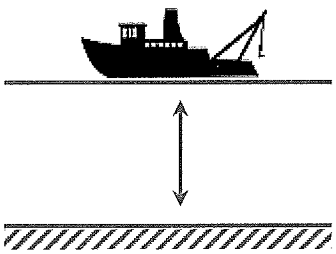
*Subcontractor: Gravity Environmental LLC* | *Vessel:*

*Sampling Crew:* | *Sampling Method:*

*Sample Location:* SS1-SS-03 | *Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)* | *Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:***

***Time:***

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/13/15

*Project No.: 0356-114-06* | *Weather:* Overcast

*Subcontractor: Gravity Environmental LLC* | *Vessel:*

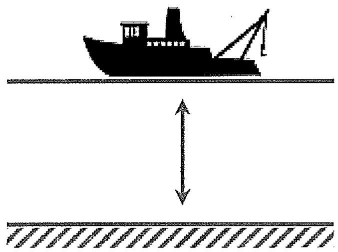
*Sampling Crew:* PDR, GL, CD | *Sampling Method:* Power Grab

*Sample Location:* SSI-SS-03 | *Target Depth ~~(ft)~~:* 12 cm

*Target Coordinates:*

*Long/Easting:* | *Lat/Northing:*

*(See navigation report for actual)*



*Water Elevation:* Approx 13.5'

*Datum:* NAVD88

*Depth to Mudline:* 4.8'

*Time:* 1109

*Mudline Elevation:* NAVD88

*Datum:* ~ -1.3 ~~ft~~

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 thru 7 | | Yes No | Discrete or Composite? |

Grab Rejected Attempts
1. Brick
2. Washout
3. Debri, brick, glass
4. Brick + asphalt
5. Cobbles, glass, debri
6. Cobbles, glass, rock
7. Washout w/ glass

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by: CD

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* Sunny, warm

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Mike, Chad, Paul, Claudia

*Sampling Method:* power grab

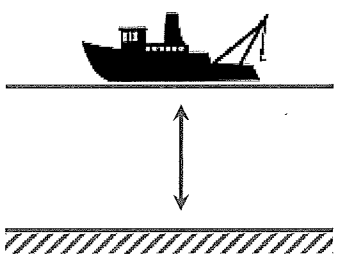
*Sample Location:* 551-55-03

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:*** 9.0'

***Time:*** 1128

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 9 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only— insufficient recovery

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* *Date:* 10/15/15

*Project No.: 0356-114-06* *Weather:* Sunny, Warm

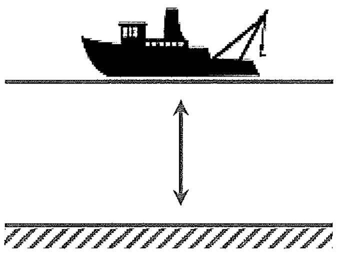
*Subcontractor: Gravity Environmental LLC* *Vessel:* Tieton

*Sampling Crew:* Mike, Chad, Paul, Claudia *Sampling Method:* Power Grab

*Sample Location:* SSI-SS-23 *Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:* ____________ *Lat/Northing:* ____________
*(See navigation report for actual)*



***Water Elevation:*** ____________

***Datum:*** ____________

***Depth to Mudline:*** 9.0'

***Time:*** ~~1129~~ 1144

***Mudline Elevation:*** ____________

***Datum:*** ____________

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only— L rock in the jaw. Debri in grab.

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/15/15

*Project No.: 0356-114-06* | *Weather:* Sunny, Warm

*Subcontractor: Gravity Environmental LLC* | *Vessel:* Tieton

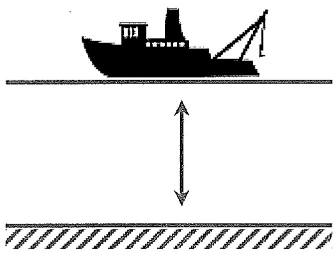
*Sampling Crew:* Mike, Chad, Paul, Claudia | *Sampling Method:* Power Grab

*Sample Location:* SSI-SS-03 | *Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:* | *Lat/Northing:*

*(See navigation report for actual)*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* ~~9.0'~~ 12.8'

*Time:* 1157

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | 21 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay — silty fine to Med sand w/ trace wood debri' only occ. roots.

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent — shells + shell fragments

Vegetation/Biota (describe):

Worms

Other Debris (describe):

Rope — on mud line - weathered lumber. (Planks, construction lumber)

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

None. Homogenous

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Very Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present — No sheen

Comments/Other Observations:

PID = 0ppm

Sample @ 1205

4 Jars to ARI + 1 Bioassay bucket ~~for~~ to ARI

~~AND SSI-SS-DUP-03~~ not enough volume

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* overcast, cool

*Subcontractor: Gravity Environmental LLC*

*Vessel:* N/A sampled @ low tide

*Sampling Crew:* Paul

*Sampling Method:* by hand, spoon

*Sample Location:* SSI-SS-04

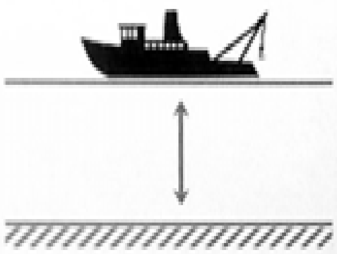
*Target Depth (ft):* 4"-5"

*Target Coordinates:*

*Long/Easting:* -122.49076

*(See navigation report for actual)*

*Lat/Northing:* 48.74211



**Water Elevation:** 3.3

**Datum:** MLLW

**Depth to Mudline:** 0

**Time:** 2230

**Mudline Elevation:**

**Datum:**

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 12 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): crabs, worms

Other Debris (describe): glass, bricks

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Large bolders, cobbles & bricks over brown F-M Sa, sand to 4"-5" over more cobbles, bricks

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: PID = 0.0

Logged by: PDJ

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* lt rain, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:* GL/CV/PR

*Sampling Method:* Power Grab

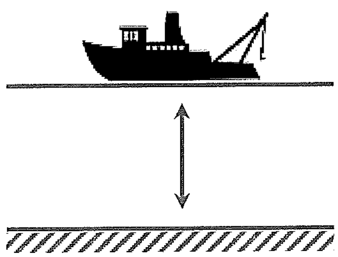
*Sample Location:* SS1-SS-05

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:*** ~3

***Datum:*** NAVD88

***Depth to Mudline:*** 7.8

***Time:*** 12:00

***Mudline Elevation:*** -4.8

***Datum:*** NAVD88

***Acceptance Criteria:***

- ✓ Overlying water present
- ✓ Low turbidity in overlying water
- ✓ Grab not over-filled
- ✓ Sediment surface ~flat
- ✓ No winnowing/washout
- ✓ Target penetration achieved 14

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 14 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay >50% silt (organic) <50% f sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% (trace wood).

Shell hash (circle): Present Absent

Vegetation/Biota (describe): trace worms: very small. Less than 1mm diameter x one to two cm long. Trace shelled animal (two of them). One live clam ~3 cm. ~~Several~~ snails.

Other Debris (describe): 2 small pieces of wood. Splinters ~4 cm in length. Likely processed due to several flat sides. Does not appear to be treated (no odor, PID, sheen, discoloration).

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Top 2 cm is olive colored, sed is black below 2 cm

RPD depth (cm): 2 cm

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: No eelgrass
Sample time =12:00
PID = 0.0

Logged by: GRL

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Cloudy, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:* GL/PR/CV

*Sampling Method:* Power Grab

*Sample Location:* SS1-SS-~~08~~ 06

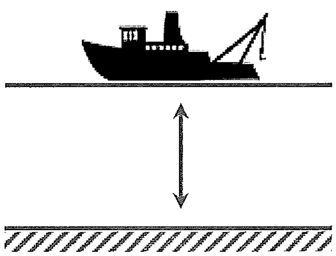
*Target Depth (~~ft~~):* 12 cm

*Target Coordinates:*

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~4

*Datum:* NAVD88

*Depth to Mudline:* 8.7'

*Time:* 12:36

*Mudline Elevation:* -4.7

*Datum:* NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 17 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 17 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay >50% fine sand <50% silt

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% trace wood: Twigs. Does not appear to be processed.

Shell hash (circle): Present Absent

Vegetation/Biota (describe): Trace worms as in SS-05. One small flatworm. Dead eelgrass. One live clam, ~3 cm.

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): ~0.5 cm olive colored

RPD depth (cm): 0.5 cm

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Some eelgrass mixed in surface: mostly dead.
PID = 0.0
Sample time = 12:36

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

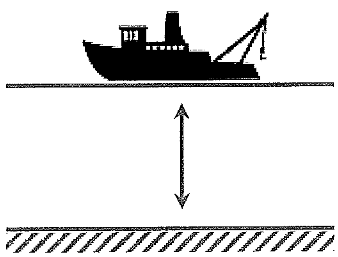
*Sample Location:* SS1-SS-07

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* 3.53

*Datum:* NAVD88

*Depth to Mudline:* 7.4

*Time:* 13:05

*Mudline Elevation:* -3.87

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobbles

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/12/15

*Project No.: 0356-114-06* | *Weather:*

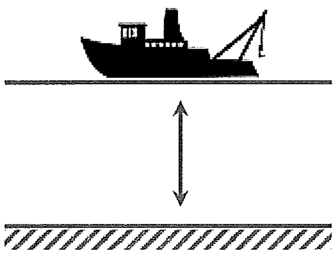
*Subcontractor: Gravity Environmental LLC* | *Vessel:*

*Sampling Crew:* | *Sampling Method:*

*Sample Location:* SS1-SS-07 | *Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:* | *Lat/Northing:*
*(See navigation report for actual)*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): Cobbles

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

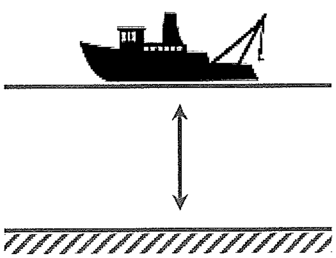
*Sample Location:* SS1-SS-07

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | 4 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

**SEDIMENT SAMPLING FORM—SURFACE GRABS**

*Project:R.G. Haley Supplemental Sediment Investigation* *Date:* 10/12/15

*Project No.: 0356-114-06* *Weather:* Cloudy, 50s

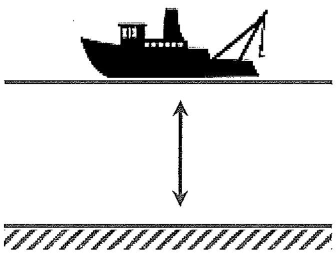
*Subcontractor: Gravity Environmental LLC* *Vessel:*

*Sampling Crew:* *Sampling Method:*

*Sample Location:* SS1-SS-07 *Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:* *Lat/Northing:*
*(See navigation report for actual)*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 4 | 7 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* lt rain, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power grab

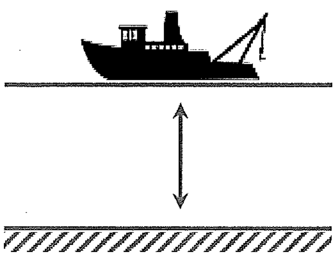
*Sample Location:* SS1-SS-07

*Target Depth (~~ft~~):* 12 cm

***Target Coordinates:***

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:*** 3.53

***Datum:*** NAVD88

***Depth to Mudline:*** 7.4

***Time:*** 13:05

***Mudline Elevation:*** -3.87

***Datum:*** NAVD88

***Acceptance Criteria:***

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- *Target penetration achieved*
  11 cm out of 12 (13)

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 5 | 11 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay + silt, +tg coarse gravel

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% Trace wood. Not processed. Then fd one piece of potentially processed wood (see "other debris")

Shell hash (circle): Present Absent

Vegetation/Biota (describe): One piece live eelgrass. 1 live clam. 1 small ~~snail~~ snail (<1cm)

Other Debris (describe): One piece of wood on surface. Possibly processed because flat on one side. ~5"x1" x 0.25". No evidence of wood treatment.

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Top 3cm is olive

RPD depth (cm): 3 cm

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time 13:05
PID=0.6

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* lt rain, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power grab

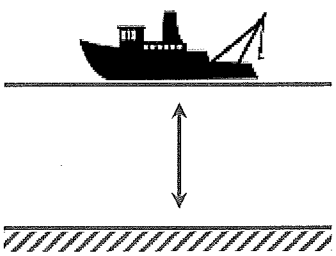
*Sample Location:* SS1-SS-07

*Target Depth ~~(ft)~~:* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:** 3.53

**Datum:** NAVD88

**Depth to Mudline:** 7.4

**Time:** 13:05

**Mudline Elevation:** -3.87

**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved*

13 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 6 | 13 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay + silt, + tr coarse gravel + 1 cobble

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): Worms, one live clam.

Other Debris (describe): 1 dead clam shell.

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Top 3 cm olive

RPD depth (cm): 3 cm

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Sample time 13:05
PID=0.6

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power Grab

*Sample Location:* SS1-SS-08

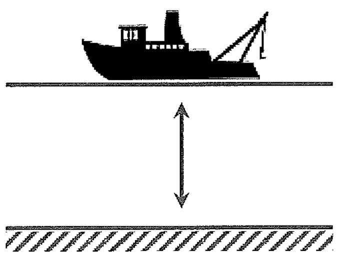
*Target Depth ~~(ft)~~:* 12 cm

*Target Coordinates:*

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:** 4.37

**Datum:** NAVD88

**Depth to Mudline:** 26.5

**Time:** ~~1345~~ 1350

**Mudline Elevation:** -22.13

**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 24cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 24 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay >50% silt <50% sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): Dead clam, mussel shells

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): —

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present <1cm sheen. Somewhat blocky, does not spread. 4 total sheen spots white

Comments/Other Observations: PID = 1.6
Sample time 13:50

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

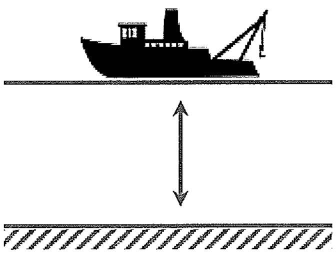
*Sample Location:* SS1-SS-09

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* 3.5

*Datum:* NAVD88

*Depth to Mudline:* 21.5

*Time:* 14:05

*Mudline Elevation:* ~18

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

Sampler angled

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | <12 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power Grab

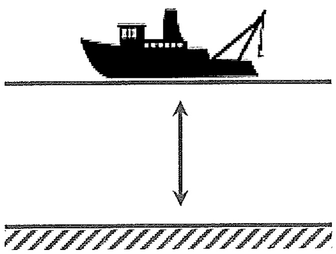
*Sample Location:* SS1-SS-~~08~~ 09

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:** 3.5
**Datum:** NAVD88
**Depth to Mudline:** 21.5
**Time:** 14:10
**Mudline Elevation:** -18
**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 23 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | 23 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay tr fine sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): tr shell fragments

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): —

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:
Sample time = 14:10
PID=0.0

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

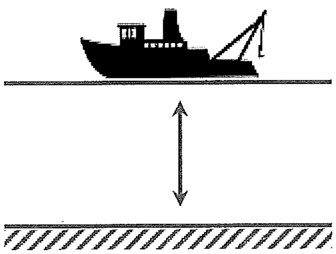
*Sample Location:* SS1-SS-10

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:** ~5

**Datum:** NAVD 88

**Depth to Mudline:** 28.8

**Time:** 14:25

**Mudline Elevation:** -23.8

**Datum:** NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | over penetration | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power Grab

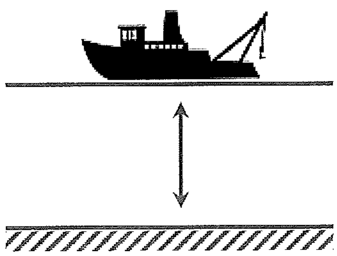
*Sample Location:* SS1-SS-10

*Target Depth ~~(ft)~~:* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~5

*Datum:* NAVD88

*Depth to Mudline:* 28.8

*Time:* 14:25

*Mudline Elevation:* -23.8

*Datum:* NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved*

14 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | 14 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay tr fine sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): —

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Upper 9 cm is siltier; lower 3 cm becomes sandier.

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time = 14:35
PID = 1.8

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Cloudy

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

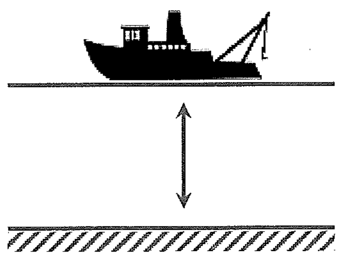
*Sample Location:* SS1-SS-11

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~5.8

*Datum:* NAVD88

*Depth to Mudline:* 30.1

*Time:* 1530

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

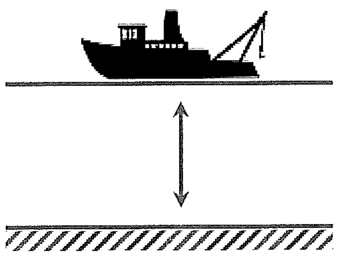
*Sample Location:* SS1 - SS - 11

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/12/15

*Project No.: 0356-114-06* | *Weather:* Clouds, ~~60~~ upper 50s

*Subcontractor: Gravity Environmental LLC* | *Vessel:*

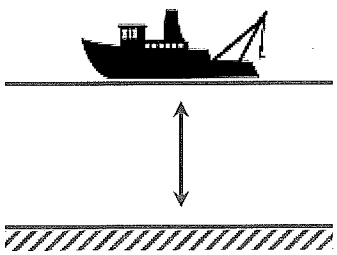
*Sampling Crew:* | *Sampling Method:* Power Grab

*Sample Location:* SS1-SS-011 | *Target Depth (ft):* 12cm

*__Target Coordinates:__*

*Long/Easting:* | *Lat/Northing:*

*(See navigation report for actual)*



*Water Elevation:* ~5.8

*Datum:* NAVD88

*Depth to Mudline:* 30.1

*Time:* 15:30

*Mudline Elevation:* -24.3

*Datum:* NAVD88

*__Acceptance Criteria:__*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 22cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | 22 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% None in sample interval; wood @ 20cm

Shell hash (circle): Present Absent

Vegetation/Biota (describe): —

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Upper 20 cm is silt; wood is present in jaws of sampler below 20cm. Wood appears processed due to flat sides. No indication of treatment. Largest piece appears at least 8" long

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time = 15:40
PID=0.0

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* lt rain, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power Grab

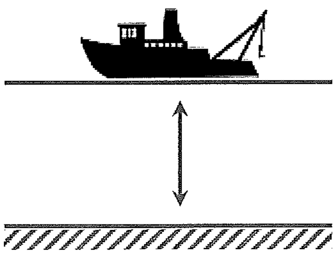
*Sample Location:* SS1-SS-12

*Target Depth ~~(ft)~~:* 12cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~5.8

*Datum:* NAVD88

*Depth to Mudline:* 29.6

*Time:* 1400

*Mudline Elevation:* -23.8

*Datum:* NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 21cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 21 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): Worms. <1mm thick.

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): Silt possibly laminated: not obvious, but faint lamination visible: <1mm laminae.

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time = 1600
PID = 0.0

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power grab

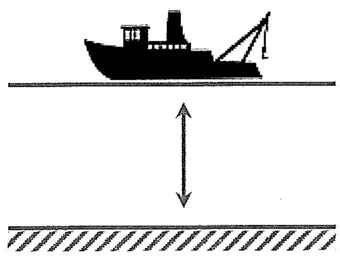
*Sample Location:* SS1-SS-13

*Target Depth (ft):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~6

*Datum:* NAVD88

*Depth to Mudline:* 33.3

*Time:* 16:20

*Mudline Elevation:* -27.3

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe): one lg piece wood (not processed)

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/12/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

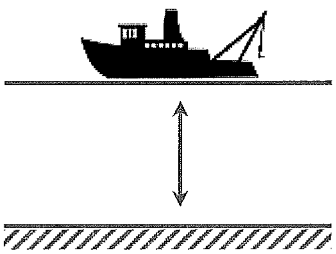
*Sample Location:* SS1-SS-13

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~6

*Datum:* NAVD88

*Depth to Mudline:* 33.3

*Time:* 16:20

*Mudline Elevation:* -27.3

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* *Date:* 10/12/15

*Project No.: 0356-114-06* *Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC* *Vessel:*

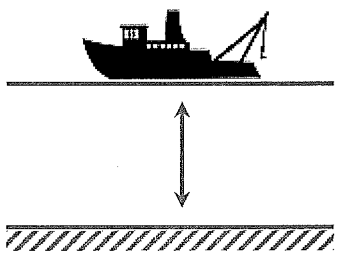
*Sampling Crew:* *Sampling Method:* Power Grab

*Sample Location:* SS1-SS-13 *Target Depth (~~ft~~):* 12 cm

*Target Coordinates:*

*Long/Easting:* *Lat/Northing:*

*(See navigation report for actual)*



*Water Elevation:* ~6

*Datum:* NAVD88

*Depth to Mudline:* 33.3

*Time:* 16:20

*Mudline Elevation:* -27.3

*Datum:* NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved*

22 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | 22 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay tr f SAND

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): —

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): —

RPD depth (cm): —

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time 1430
PID = 0.0

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

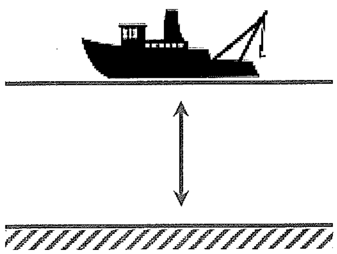
*Sample Location:* SS1-SS-14

*Target Depth (ft):*

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:* 29.4

*Time:* 0910

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* Date: 10/13/15

*Project No.: 0356-114-06* Weather: Overcast

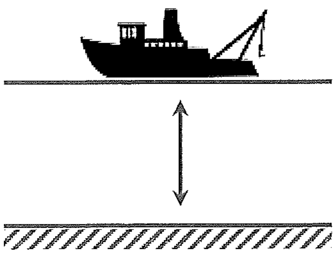
*Subcontractor: Gravity Environmental LLC* Vessel:

*Sampling Crew:* GL, CD, PDR Sampling Method: Power Grab

*Sample Location:* SSI-SS-14 Target Depth (~~ft~~): 12cm

*Target Coordinates:*

*Long/Easting:* Lat/Northing:
*(See navigation report for actual)*



**Water Elevation:** Approx ~5'

**Datum:** NAVD88

**Depth to Mudline:** 29.4

**Time:** 0910

**Mudline Elevation:** -24'

**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ Overlying water present
- ✓ Low turbidity in overlying water
- ✓ Grab not over-filled
- ✓ Sediment surface ~flat
- ✓ No winnowing/washout
- ✓ Target penetration achieved 16cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | 16 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay trace w/ fine sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): None

Other Debris (describe): None. One piece of bark, red, flat inner section, potentially processed. Highly weathered/degraded.

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): None

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

PID = 0.2 ppm

sample time 0920
4 jars ARI for Archive.
3 " Frontier

Logged by: CD

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50s

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:* GL/PR

*Sampling Method:* Power Grab

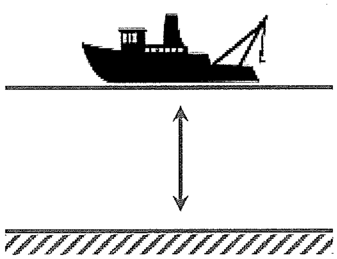
*Sample Location:* SS1-SS-15

*Target Depth ~~(ft)~~:* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:* ~5.8

*Datum:* NAVD88

*Depth to Mudline:* 27.4 *

*Time:* 08:30

*Mudline Elevation:* -21.6

*Datum:* NAVD88

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: 1 | Penetration Depth (cm): | Sample Accepted (circle): Yes No | Sample Type (circle): Discrete or Composite? |
|---|---|---|---|

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Depth inconsistent w/ Figure 5: Fig 5 indicated we
* should be at >25' NAVD88.

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:*

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:*

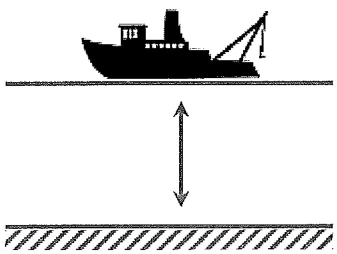
*Sample Location:* SS1-SS-15

*Target Depth (~~ft~~):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



***Water Elevation:***

***Datum:***

***Depth to Mudline:***

***Time:***

***Mudline Elevation:***

***Datum:***

*Acceptance Criteria:*

- *Overlying water present*
- *Low turbidity in overlying water*
- *Grab not over-filled*
- *Sediment surface ~flat*
- *No winnowing/washout*
- *Target penetration achieved*

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 2 | | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

Other Debris (describe):

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

RPD depth (cm):

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* Clouds, 50's

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:*

*Sampling Method:* Power Grab

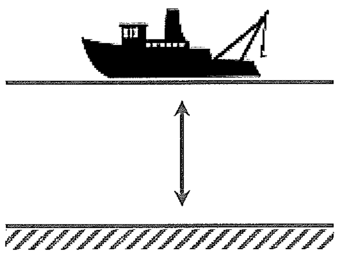
*Sample Location:* SS1-SS-15

*Target Depth (~~ft~~):* 12 cm

*Target Coordinates:*

*Long/Easting:*
*(See navigation report for actual)*

*Lat/Northing:*



*Water Elevation:*

*Datum:*

*Depth to Mudline:*

*Time:*

*Mudline Elevation:*

*Datum:*

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 14 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 3 | 14 | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75% tr wood debris below ~13cm wood splinter, possibly processed, no evidence of treatment

Shell hash (circle): Present Absent

Vegetation/Biota (describe): v small worms, a few shell fragments

Other Debris (describe): —

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): top 3 cm olive brown

RPD depth (cm): 3 cm

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: Sample time 08:40
PID = 0.0

Logged by:

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* Overcast

*Subcontractor: Gravity Environmental LLC*

*Vessel:*

*Sampling Crew:* GL, CD, PDR

*Sampling Method:* Power Grab

*Sample Location:* SSI-SS-16

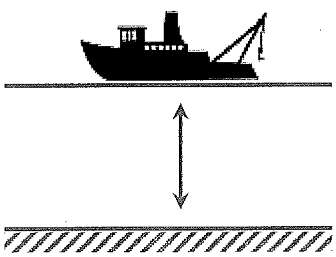
*Target Depth* ~~*(ft)*~~*:* 12cm

*Target Coordinates:*

*Long/Easting:*

*(See navigation report for actual)*

*Lat/Northing:*



**Water Elevation:** Approx ~5'

**Datum:** NAVD88

**Depth to Mudline:** 30.4'

**Time:** 0937

**Mudline Elevation:** -25'

**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ Overlying water present
- ✓ Low turbidity in overlying water
- ✓ Grab not over-filled
- ✓ Sediment surface ~flat
- ✓ No winnowing/washout
- ✓ Target penetration achieved 14 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 14cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay trace fine sand

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe): None

Other Debris (describe): None

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): None

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

PID = 0ppm

Sample time 0940
2 to ARI
1 to Frontier

Archived

Logged by: CD

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/13/15

*Project No.: 0356-114-06* | *Weather:* Overcast

*Subcontractor: Gravity Environmental LLC* | *Vessel:*

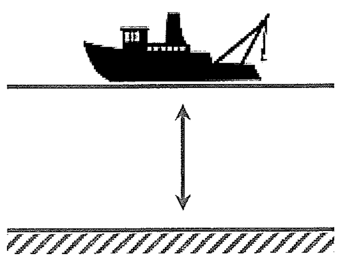
*Sampling Crew:* GL, CD, ADR | *Sampling Method:* Power Grab

*Sample Location:* SSI-SS-17 | *Target Depth (~~ft~~):* 12 cm

*Target Coordinates:*

*Long/Easting:* | *Lat/Northing:*

*(See navigation report for actual)*



**Water Elevation:** Approx ~ 5.5'

**Datum:** NAVD88

**Depth to Mudline:** 32.3'

**Time:** 0957

**Mudline Elevation:** -27'

**Datum:** NAVD88

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 18 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 18 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Sticky plastic silt.

Shell hash (circle): Present Absent

Vegetation/Biota (describe):

occ. worm, shell fragments

Other Debris (describe):

None

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe):

0 to 4 cm soft sed, followed by stiff sediment

RPD depth (cm): 0

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations:

PID = 0 ppm

Sample time 1003
4 to ARI
3 to Frontier

Archived

Logged by: CD

## SEDIMENT SAMPLING FORM—SURFACE GRABS

*Project:R.G. Haley Supplemental Sediment Investigation* | *Date:* 10/13/15

*Project No.: 0356-114-06* | *Weather:* Overcast

*Subcontractor: Gravity Environmental LLC* | *Vessel:*

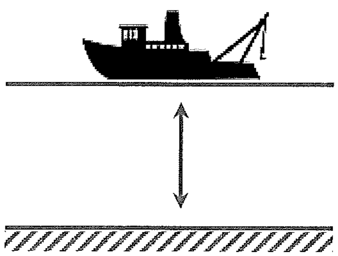
*Sampling Crew:* GL, CD, PDR | *Sampling Method:* Power Grab

*Sample Location:* SSI-SS-18 | *Target Depth (~~ft~~):* 12cm

*Target Coordinates:*

*Long/Easting:* | *Lat/Northing:*

*(See navigation report for actual)*



**Water Elevation:** Approx 4.5'

**Datum:** NAVD88

**Depth to Mudline:** 28.1' w/ angle

**Time:** 1021

**Mudline Elevation:** NAVD88

**Datum:** -24'

*Acceptance Criteria:*

- ✓ *Overlying water present*
- ✓ *Low turbidity in overlying water*
- ✓ *Grab not over-filled*
- ✓ *Sediment surface ~flat*
- ✓ *No winnowing/washout*
- ✓ *Target penetration achieved* 14 cm

| Grab No.: | Penetration Depth (cm): | Sample Accepted (circle): | Sample Type (circle): |
|---|---|---|---|
| 1 | 14 cm | Yes No | Discrete or Composite? |

Fill out for accepted grab only—

Sediment Type (circle): Cobble Gravel Coarse Sand Medium Sand Fine Sand Silt/Clay

Wood debris (by volume) (circle): None <25% 25-50% 50-75% >75%

Shell hash (circle): Present Absent

Vegetation/Biota (describe):
green + brown worms (moderate amount)

Other Debris (describe):
None

Sediment Color (circle): Olive Light Brown Dark Brown Gray Black

Stratification/Layering (describe): None

RPD depth (cm): 1cm (olive)

Sediment Odor Type (circle): None Petroleum $H_2S$

Odor Strength (circle): Light Moderate Strong Very Strong

Petroleum Sheen (circle): None Slight Moderate Heavy Product present

Comments/Other Observations: SSI-SS-18_0-12 Sample 1025 and SSI-SS-DUP-02
2 to ARI → "
1 to Frontier → "
PID = 0 ppm

Logged by: CD Collected Rinsate_151013 from deconned Power Grab

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/14/15

*Project No.: 0356-114-06*

*Weather:* Sunny, 60's

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Hannah, Mike, Chad

*Sampling Method:* Vibracore

*Sample Location:* SS1-SC-01

*Target Depth (ft):* 8 ft

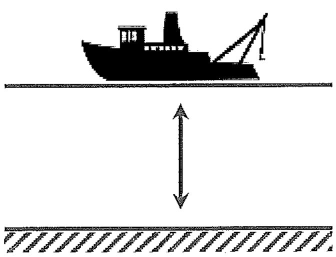
*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*

*Enter initial loc. info./update for final accepted core:*



*Water Elevation:* 4.75

*Datum:* MLLW

*Depth to Mudline:* 8.2 10.4 10.8

*Time:* 1415 1610 1800

*Mudline Elevation:*

*Datum:*

*Acceptance criteria:*

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 1420 | | | 4 | 6.5 | (possible slough in sampler) | N |
| 2 | 1455 | | | 6 | 6.5 | (possible slough in sampler) | ~~N~~ Y |
| 3 | 1610 | | | 5 | 1.5 | — | N |
| ① 4 | 1655 | | | 5 | 3.5 | — | N |
| 5 | 1800 | | | 5.5 | 4 | — | N |
| | | | | | | | |
| | | | | | | | |

**Comments:** #1 recovered excess sediment. Drove only 4 ft, but recovered 6.6'. Likely due to choppiness and movement of corer tube while dropping.
#2 reset spuds for better anchoring, shift to east. About 9ft west of location. Chad sets up new tube. Hold onto tube #1.
#3 reposition again and attach frame. Refusal at 5 ft from wood, plastic, hair, brick, shells, foil material
① Reuse cleaned core tube from previous run. #4 hit refusal at 5 ft. Slight sheen while pulling out core, sed & water

Logged by:

#5 failed attempt. Encountered debris at 5 ft. Disposed of core. Kept core from 1st run for tomorrow. 3" triangular ceramic plate encountered at base of core tube.

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Project No.: 0356-114-06*

*Subcontractor: Gravity Environmental LLC*

*Sampling Crew:* Paul, Hannah, Mike, Chad

*Sample Location:* SSI-SC-02

*Target Coordinates:*

*Long/Easting:*

*Date:* 10/14/15

*Weather:* partly sunny, 60's

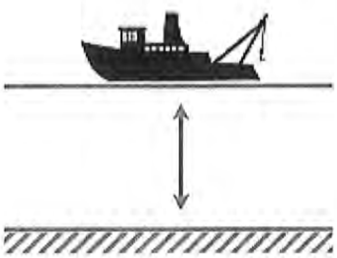
*Vessel:* Tieton

*Sampling Method:* Vibracore

*Target Depth (ft):* 8'

*Core Lined (circle):* Yes No

*Lat/Northing:*



*Enter initial loc. info./update for final accepted core:*

*Water Elevation:* 7.0

*Datum:* MLLW

*Depth to Mudline:* 4.0

*Time:* 0925

*Mudline Elevation:*

*Datum:*

*Acceptance criteria:*

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 0930 | | | 0.5 | 0.5 | — | N |
| ① 2 | 0935 | | | 3 | 0.9 | — | N |
| ① 3 | 0950 | | | 1.5 | 0.5 | — | N |
| ① 4 | 1005 | | | 1.5 | 1.0 | — | N |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Comments:** #1 cobbles and boulders caused refusal just below mudline. No fame.

① Same core tube as previous run

#2 coarse gravel, glass, bricks

#4 hit boulder or concrete @ 1.5'

see back for additional observations →

Logged by:

From Hannah McDonough – email 10/19 12:39pm

SC-02, run 2
3 feet of penetration but only
recovered ~1 foot of material

Material was brown sand with silt,
gravel, glass, shell, concrete & brick.
Observed glass was clear, green or brown –
ranging from 1 cm diameter to 5 cm diameter.
One piece was likely an old power pole insulator
Brick fragments were small – < 0.5 inches in length/width

These observations were made on
material prior to returning to point
of sampling – no opportunity to
view layering/stratification in core

Photos uploaded to P-drive

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/14/15

*Project No.: 0356-114-06*

*Weather:* Sunny, 65°

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Paul, Hannah, Mike, Chad

*Sampling Method:* Vibracore

*Sample Location:* SS1-SC-03

*Target Depth (ft):* 8 ft

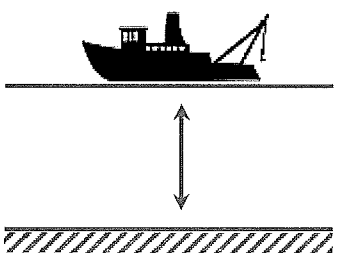
*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*

*Enter initial loc. info./update for final accepted core:*



*Water Elevation:* 5.0

*Datum:* MLLW

*Depth to Mudline:* 7.6 ft

*Time:* 10

*Mudline Elevation:*

*Datum:*

*Acceptance criteria:*

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual | | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| | | Long/Easting | Lat/Northing | | | | |
| 1 | 1055 | | | 7.5 | 5.0 | — | N |
| 2 | 1200 | | | 0.5 | 0.5 | — | N |
| 3 | 1220 | | | 8 | 8 | 0 | Y |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Comments:** #1 stop at 1130 after 35 mins of coring. Down about 5 ft. Restard coring after rest @ 1135. No frame, 10 ft tube

#2 reposition boat. Pivot off spud.. Recore with 8 ft tube. Save attempt #1. Stuck for 20 mins at ~0.5 ft. Pull up core. Bottom of tube is chewed up by wood, glass, brick fragments. Processed wood in core.

Logged by:

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/24/15

*Project No.: 0356-114-06*

*Weather:* Foggy, cool

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Paul, Hannah, ~~Matt~~ Mike, Chad

*Sampling Method:* Vibracore

*Sample Location:* SSI-SC-04

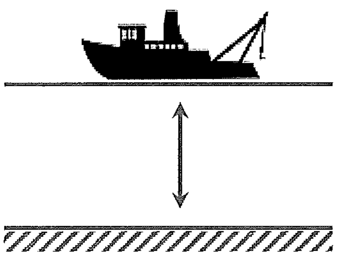
*Target Depth (ft):* 8'

*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*



*Enter initial loc. info./update for final accepted core:*

*Water Elevation:* 7.2

*Datum:* MLLW

*Depth to Mudline:* 5.2

*Time:* 815

*Mudline Elevation:*

*Datum:*

*Acceptance criteria:*

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 0825 | | | 1.5 | 1.3 | — | N |
| ① 2 | 0837 | | | 2.0 | 1.5 | — | N |
| 3 | 0855 | | | 3.0 | 2.5 | — | N |
| 4 | 0910 | | | 3.0 | 2.0 | — | N |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Comments: #1 bolders and cobbles, refusal just below mudline
① same core tube as previous run
#2 same as #1 – removed frame for attempt #3
#3 same as #1

Logged by: RBL

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/15/15

*Project No.: 0356-114-06*

*Weather:* clear, cool

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Mike, Chad, Paul, Claudia

*Sampling Method:* Vibracore

*Sample Location:* SSI-SC-4

*Target Depth (ft):* 8'

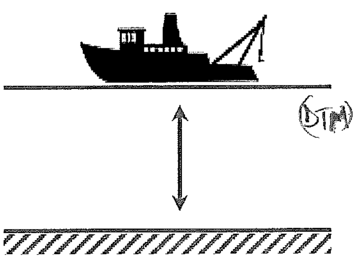
*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*

*Enter initial loc. info./update for final accepted core:*



(DTM)

*Water Elevation:* 7.8

*Datum:* MLLW

*Depth to Mudline:* 6.9'

*Time:* 0822

*Mudline Elevation:*

*Datum:*

*Acceptance criteria:*

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 833 | | 7 meters from target coordinate | 2.5 | 2.5 | | N DTM=6.9' |
| * 2 | 921 | | same location | 5.0 | 4.8 | | Y DTM=6.9' |
| 3 | 1014 | | | 2.0 | 2.0 | | N DTM=6.2' |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Comments:** (1) same core tube as previouse attempt

#1 10' core w/frame

* #2 8' core w/no frame (probing the hamering 0930-1003) will keep & sample 0-2, 2-4

#3 10' core w/no frame after 10 mins & ~2' penetration core head broke.

Logged by: RDP

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* cloudy, 64

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* Paul, ~~Mark~~ Mike, Chad

*Sampling Method:* Vibracore

*Sample Location:* SSI-SC-05

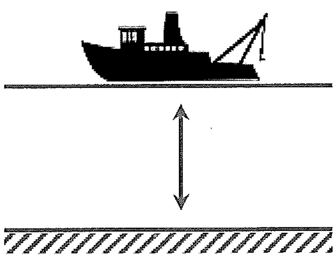
*Target Depth (ft):* 8'

*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*



*Enter initial loc. info./update for final accepted core:*

**Water Elevation:** 6 / 5.5 ~~+5.05~~

**Datum:** MLLW / NAVD88

**Depth to Mudline:** 9.5

**Time:** 1537

**Mudline Elevation:** ~~-4.47~~ -3.5 / -4

**Datum:** NAVD88 / MLLW

***Acceptance criteria:***

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 1540 | | | 8.0 | 6.2 | 22% | Y |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Comments:**

Logged by: [illegible]

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* cloudy, 60°

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* PDP, Mike, Chad

*Sampling Method:* Vibracore

*Sample Location:* SSI-SC-6

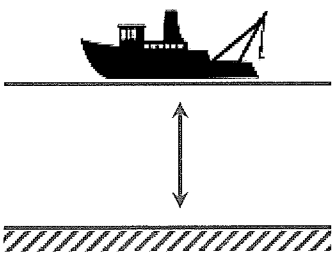
*Target Depth (ft):* 8'

*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*



*Enter initial loc. info./update for final accepted core:*

*Water Elevation:* 4.8 / 4.3

*Datum:* MLLW / NAVD88

*Depth to Mudline:* 6.8'

*Time:* 1330

*Mudline Elevation:* -2.47

*Datum:* NAVD88

*Acceptance criteria:*

- y • *Target penetration achieved*
- y • *Core tube intact/ no obstructions*
- y • *Calculated compaction < 25%*
- y • Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 1335 | | | ≈6' | 4' | 33% | N |
| 2 | 1350 | | | 7.0' | 6.3' | 10% | Y |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Comments: core tube re-used from attempt 1 after sediment removed and flushed w/ seawater

Logged by: PDP

## SEDIMENT SAMPLING FORM--CORES

*Project: R.G. Haley Supplemental Sediment Investigation*

*Date:* 10/13/15

*Project No.: 0356-114-06*

*Weather:* cloudy, 60°

*Subcontractor: Gravity Environmental LLC*

*Vessel:* Tieton

*Sampling Crew:* PDR, Mike, Chad

*Sampling Method:* Vibracore /

*Sample Location:* SSI-SG-7

*Target Depth (ft):* 8'

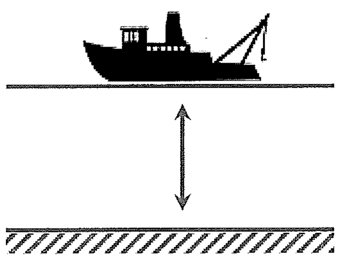
*Target Coordinates:*

*Core Lined (circle):* Yes No

*Long/Easting:*

*Lat/Northing:*

*Enter initial loc. info./update for final accepted core:*



**Water Elevation:** 5.25 / 4.78

**Datum:** MLLW / NAVD88

**Depth to Mudline:** 8.2'

**Time:** 1419

**Mudline Elevation:** -3.42

**Datum:** WGS 84 NAVD88

***Acceptance criteria:***

- *Target penetration achieved*
- *Core tube intact/ no obstructions*
- *Calculated compaction < 25%*
- Water

| Run No. | Time | Actual Long/Easting | Actual Lat/Northing | Penetration Depth (ft) | Recovery Length (ft) | Compaction (%) | Accept? |
|---|---|---|---|---|---|---|---|
| 1 | 1429 | | | 4.5' | 3.7' | 17% | N |
| ①2 | 1445 | | | 8.0 | 7.4' | 7.5% | Y |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Comments:** ① same core tube as previous run

Logged by: PDR

# A.3 Supplemental Sediment Investigation Subsurface Logs - 2015

## SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS GRAPH | SYMBOLS LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>MORE THAN 50% RETAINED ON NO. 200 SIEVE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES |
| | | GRAVELS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE | CLEAN SANDS<br>(LITTLE OR NO FINES) | | SW | WELL-GRADED SANDS, GRAVELLY SANDS |
| | | | | SP | POORLY-GRADED SANDS, GRAVELLY SAND |
| | | SANDS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>MORE THAN 50% PASSING NO. 200 SIEVE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | | | OH | ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

## ADDITIONAL MATERIAL SYMBOLS

| SYMBOLS GRAPH | SYMBOLS LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|
| | AC | Asphalt Concrete |
| | CC | Cement Concrete |
| | CR | Crushed Rock/ Quarry Spalls |
| | TS | Topsoil/ Forest Duff/Sod |

### Groundwater Contact

**Measured groundwater level in exploration, well, or piezometer**

**Measured free product in well or piezometer**

### Graphic Log Contact

**Distinct contact between soil strata**

**Approximate contact between soil strata**

### Material Description Contact

**Contact between geologic units**

**Contact between soil of the same geologic unit**

### Sampler Symbol Descriptions

- **2.4-inch I.D. split barrel**
- **Standard Penetration Test (SPT)**
- **Shelby tube**
- **Piston**
- **Direct-Push**
- **Bulk or grab**
- **Continuous Coring**

**Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.**

**A "P" indicates sampler pushed using the weight of the drill rig.**

**A "WOH" indicates sampler pushed using the weight of the hammer.**

### Laboratory / Field Tests

| | |
|---|---|
| %F | Percent fines |
| %G | Percent gravel |
| AL | Atterberg limits |
| CA | Chemical analysis |
| CP | Laboratory compaction test |
| CS | Consolidation test |
| DS | Direct shear |
| HA | Hydrometer analysis |
| MC | Moisture content |
| MD | Moisture content and dry density |
| OC | Organic content |
| PM | Permeability or hydraulic conductivity |
| PI | Plasticity index |
| PP | Pocket penetrometer |
| PPM | Parts per million |
| SA | Sieve analysis |
| TX | Triaxial compression |
| UC | Unconfined compression |
| VS | Vane shear |

### Sheen Classification

| | |
|---|---|
| NS | No Visible Sheen |
| SS | Slight Sheen |
| MS | Moderate Sheen |
| HS | Heavy Sheen |
| NT | Not Tested |

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

## KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

| Drilled | Start 10/14/2015 | End 10/14/2015 | Total Depth (ft) | 6 | Logged By GRL/HM Checked By | Driller | Gravity Environmental, LLC | Drilling Method | Vibracore |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Mudline Elevation (ft) / Vertical Datum | -5.89 NAVD88 | Hammer Data | | Drilling Equipment | |
| Easting (X) / Northing (Y) | 1239695.34 / 639367.68 | System Datum | NAD83 (feet) | Groundwater: Date Measured | Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 4.51 ft (NAVD88)

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name / Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 72 | | | SSI-SC-01 0-2 | | | SM | Black silty fine to medium sand with pockets of silt from 0 to 6 feet (loose)<br>Trace wood fibers from 0 to 2 feet | | | Live clams at surface |
| | | | | | | SSI-SC-01 DUP-01 | | | | | NS | 8.9 | |
| | | | | | | | | | | 2- by 2-inch wood chunk | | | |
| | | | | | | | | | | Glass | NS | 4.0 | $H_2S$ odor |
| | | | | | | SSI-SC-01 2-4 | | | | Wood chunk | NS | 202.7 | Slight $H_2S$ odor |
| | | | | | | | | | | Glass | | | |
| | | | | | | | | | | 1- by 1-foot clear plastic | NS | 20.6 | $H_2S$ odor |
| -10 | | | | | | SSI-SC-01 4-6 | | | | | NS | 24.6 | |
| | | | | | | | | | | Angular and rounded coarse gravel<br>Glass and degraded tar paper | | | |
| | 5 | | | | | | | | | Multiple glass fragments | | | |
| | | | | | | | | | | | NS | 15.7 | $H_2S$ odor |
| | | | | | | | | | | Glass | | | |
| | | | | | | | | | GM | Black silty coarse gravel (dense) (possible native)<br>Shell fragment | | | |

Note: Please see Figure A-1 for explanation of symbols

# Log of Boring SSI-SC-01

GEOENGINEERS

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

Figure A-2
Sheet 1 of 1

| Drilled | Start | End | Total Depth (ft) | Logged By | Driller | Drilling Method |
|---|---|---|---|---|---|---|
| | 10/14/2015 | 10/14/2015 | 8 | GRL<br>Checked By | Gravity Environmental, LLC | Vibracore |

| | | | |
|---|---|---|---|
| Mudline Elevation (ft) / Vertical Datum | -3.09 / NAVD88 | Hammer Data | Drilling Equipment |
| Easting (X) / Northing (Y) | 1239788.45 / 639426.59 | System Datum: NAD83 (feet) | Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 4.51 ft (NAVD88)

FIELD DATA

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name / Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 96 | | | SSI-SC-03 0-2 | | | WD | Brown wood with trace silt (loose)<br>100% wood content (degraded, processed lumber, some fibers) | | | |
| | | | | | | | | | | | SS | 104.8 | $H_2S$ odor |
| | | | | | | | | | | | NS | 15.6 | $H_2S$ odor |
| -5 | | | | | | | | | SM | Dark gray silty fine to medium sand with trace wood (loose)<br>Trace wood fibers, possible roots | | | |
| | | | | | | SSI-SC-03 2-4 | | | | | | | |
| | | | | | | | | | | | SS | 3.2 | $H_2S$ odor |
| | | | | | | | | | GP | Fine to coarse gravel | | | |
| | | | | | | | | | WD | Tan wood (medium dense)<br>100% wood content (sawdust, fragments up to 2-inches long) | | | |
| | | | | | | | | | | | SS | 389.6 | $H_2S$ odor |
| | | | | | | SSI-SC-03 4-6 | | | | | | | |
| | | | | | | SSI-SC-03 DUP-02 | | | | | SS | 125.3 | $H_2S$ odor |
| | 5 | | | | | | | | | | | | |
| | | | | | | | | | | | NS | 40.8 | $H_2S$ odor |
| | | | | | | SSI-SC-03 6-8 | | | | | | | |
| | | | | | | | | | | | SS | 90.6 | $H_2S$ odor |
| -10 | | | | | | | | | | | | | |
| | | | | | | | | | SP | Black fine to medium sand with wood (medium dense) (possible native)<br>25 to 50% wood content (sawdust, fragments up to 2-inches long) | SS | 115.5 | $H_2S$ odor |

Note: Please see Figure A-1 for explanation of symbols

# Log of Boring SSI-SC-03

GeoEngineers

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

Figure A-3
Sheet 1 of 1

| Drilled | Start 10/15/2015 | End 10/15/2015 | Total Depth (ft) 4 | Logged By CVD/PDR, Checked By | Driller: Gravity Environmental, LLC | Drilling Method: Vibracore |
|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Mudline Elevation (ft) 0.41, Vertical Datum NAVD88 | Hammer Data | | Drilling Equipment |
| Easting (X) 1240482.54, Northing (Y) 639785.46 | System Datum | NAD83 (feet) | Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 7.31 ft (NAVD88)

FIELD DATA

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 48 | | | SSI-SC-04 0-2 | | | SM | Black silty fine sand with debris (shell fragments, occasional glass fragments) (soft) | | | Shell fragments |
| 0 | | | | | | SSI-SC-04 DUP-03 | | | | | NS | <1 | |
| | | | | | | | | | SW | Black fine sand with trace silt (dense) | | | |
| | | | | | | | | | | | NS | 64.6 | No wood, no biological material |
| | | | | | | SSI-SC-04 2-4 | | | GP | Black fine to coarse gravel with sand and occasional glass fragments (dense) | NS | 1.5 | No wood, no biological material |
| | | | | | | | | | | | NS | 27.6 | Moderate $H_2S$ odor |
| | | | | | | | | | | | NS | 57.2 | Slight $H_2S$ odor |
| | | | | | | | | | SM | Gray silty fine to medium sand (dense) <25% wood fibers Grades to black, loose <25% degraded wood chunks >50% shell hash at 3.75 feet | NS | 32.4 | Slight $H_2S$ odor |
| | | | | | | | | | | | SS | 60.1 | Moderate $H_2S$ odor |

Note: Please see Figure A-1 for explanation of symbols



## Log of Boring SSI-SC-04

GEOENGINEERS

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

Figure A-4
Sheet 1 of 1

| Drilled | Start 10/15/2015 | End 10/15/2015 | Total Depth (ft) | 8 | Logged By GRL/PDR Checked By | Driller | Gravity Environmental, LLC | Drilling Method | Vibracore |
|---|---|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Mudline Elevation (ft) Vertical Datum | -3.49 NAVD88 | Hammer Data | Drilling Equipment |
| Easting (X) Northing (Y) | 1240432.94 639831.19 | System Datum NAD83 (feet) | Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 6.01 ft (NAVD88)

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 72 | | | SSI-SC-05 0-2 | | | SM | Brown silty fine sand (medium dense) <25% milled wood chunks | | | Trace shell fragments |
| | | | | | | | | | | | SS | 67.6 | |
| -5 | | | | | | | | | ML | Brown silt with wood (soft) <25% wood chips | | | Trace shell fragments |
| | | | | | | | | | | | SS | 66.9 | $H_2S$ odor |
| | | | | | | SSI-SC-05 2-4 | | | | | | | |
| | | | | | | | | | WD | Brown wood with trace silt (soft) >50% sawdust | NS | 94.8 | $H_2S$ odor<br>Trace shell fragments |
| | | | | | | | | | ML | Gray silt with trace wood (soft) | | | |
| | | | | | | | | | | | SS | 99.8 | $H_2S$ odor<br>No vegetation, no biological material |
| | | | | | | SSI-SC-05 4-6 | | | | | | | |
| | | | | | | | | | | | NS | 32.8 | $H_2S$ odor |
| | 5 | | | | | | | | | | | | |
| | | | | | | | | | | | NS | 49.1 | $H_2S$ odor |
| | | | | | | SSI-SC-05 6-8 | | | | | | | |
| | | | | | | | | | | | NS | 147.2 | $H_2S$ odor |
| -10 | | | | | | | | | WD | Brown wood with trace silt (soft)<br>100% wood content at top of sample, grading to 25% to 50% | | | |
| | | | | | | | | | PEAT | Gray peat with sand (medium stiff) Degrading wood with barnacles | SS | 77.7 | $H_2S$ odor |

Note: Please see Figure A-1 for explanation of symbols

## Log of Boring SSI-SC-05

GeoEngineers

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

Figure A-5
Sheet 1 of 1

| Drilled | Start 10/13/2015 | End 10/13/2015 | Total Depth (ft) | 7 | Logged By GRL/PDR Checked By | Driller | Gravity Environmental, LLC | Drilling Method | Vibracore |
|---|---|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Mudline Elevation (ft) / Vertical Datum | -2.79 / NAVD88 | Hammer Data | Drilling Equipment |
| Easting (X) / Northing (Y) | 1240514.26 / 639964.4 | System Datum: NAD83 (feet) | Groundwater — Date Measured / Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 4.01 ft (NAVD88)

FIELD DATA

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name / Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 72 | | | SSI-SC-06 0-2 | | | SP | Dark gray fine to medium sand with trace silt (loose) Trace fine roots | | | Live shellfish |
| | | | | | | | | | ML | Gray sandy silt (medium stiff) | | | |
| | | | | | | | | | | | NS | 1.7 | |
| | | | | | | | | | | Trace non-weathered wood, cut sides/faces | SS | 126.9 | $H_2S$ odor |
| -5 | | | | | | SSI-SC-06 2-4 | | | | | SS | 120.4 | $H_2S$ odor |
| | | | | | | | | | | Becomes graded with sawdust layer (up to 2 inches thick) from 2.5 to 4 feet 25% to 50% wood content | | | |
| | | | | | | | | | | | | | Clam shell fragments |
| | | | | | | | | | | | SS | 92.0 | $H_2S$ odor |
| | | | | | | SSI-SC-06 4-6 | | | | Becomes graded with trace sawdust <25% wood content | NS | 54.0 | |
| | | | | | | | | | | 1/2 cm sawdust layer | | | |
| | 5 | | | | | | | | | | | | |
| | | | | | | | | | | | NS | 7.0 | $H_2S$ odor |
| | | | | | | SSI-SC-06 6-7 | | | | | NS | 1.2 | |
| | | | | | | | | | | Gray silt (soft) | | | |
| | | | | | | | | | | | | | No vegetation, no biological material |
| | | | | | | | | | | | NS | <1 | |

Note: Please see Figure A-1 for explanation of symbols



## Log of Boring SSI-SC-06

GeoEngineers

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

| Drilled | Start 10/13/2015 | End 10/13/2015 | Total Depth (ft) | 8 | Logged By GRL/PDR Checked By | Driller | Gravity Environmental, LLC | Drilling Method | Vibracore |
|---|---|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Mudline Elevation (ft) Vertical Datum | -3.29 NAVD88 | Hammer Data | Drilling Equipment |
| Easting (X) Northing (Y) | 1240430.59 640152.61 | System Datum: NAD83 (feet) | Groundwater — Date Measured / Depth to Water (ft) / Elevation (ft) |

Notes: Water surface elevation 4.91 ft (NAVD88)

| Elevation (feet) | Depth (feet) | Interval | Recovered (in) | Blows/foot | Collected Sample | Sample Name / Testing | Water Level | Graphic Log | Group Classification | MATERIAL DESCRIPTION | Sheen | Headspace Vapor (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 86.5 | | | SSI-SC-07 0-2 | | | SM | Gray silty fine sand (loose)<br>>50% wood content, top 3 inches with milled wood | | | Trace shell fragments |
| | | | | | | SSI-SC-07 DUP-04 | | | | | NS | 60.0 | $H_2S$ odor |
| -5 | | | | | | | | | | | NS | 101.6 | $H_2S$ odor |
| | | | | | | SSI-SC-07 2-4 | | | | 100% wood content | NS | 274.3 | $H_2S$ odor |
| | | | | | | | | | WD | Brown degraded wood (loose) | NS | 140.5 | $H_2S$ odor |
| | | | | | | SSI-SC-07 4-6 | | | | Becomes graded with silt<br>>50% wood content | NS | 93.0 | $H_2S$ odor |
| | 5 | | | | | | | | ML | Brown silt with wood (soft)<br><25% wood content | SS | 71.5 | $H_2S$ odor |
| | | | | | | SSI-SC-07 6-8 | | | | | | | |
| -10 | | | | | | | | | SM | Gray silty fine sand with trace wood (medium dense)<br>Trace wood | NS | 23.5 | $H_2S$ odor |
| | | | | | | | | | | | NS | 6.9 | $H_2S$ odor |

Note: Please see Figure A-1 for explanation of symbols

# Log of Boring SSI-SC-07

GEOENGINEERS

Project: R.G. Haley Site
Project Location: Bellingham, Washington
Project Number: 0356-114-06

Figure A-7
Sheet 1 of 1

# A.4 Pine Street Beach
# Field Forms - 2016

**SEDIMENT CORE LOG:** PSB-SC-01 (Core Location)

| Mudline Elev: ~0.34-ft | Datum: NAVD 88 | Contractor: NA | Sample Method: GRAB | Sampling Equipment: TROWEL & SPOON | |
|---|---|---|---|---|---|
| Coordinates: | Datum: | Tube Length: Penetration Depth: 2' BML | OD/ID: NA Tube Material: NA | Logged by: CD | Checked by: |

Depths to nearest 1/10 foot

| Total Core Depth | Core Interval | Interval Recovery | Sample Interval (ft) | Classification Symbol | Material/Lithology Description (color, material type, grain size, stratification, density, debris, etc.) | PID | Sheen | Odor | Vegetation/Biological Material- include type (sawdust, fibers, bark, chips, chunks, twigs, lumber, etc.) and amount of wood debris, by volume (none, <25%, 25-50%, >50%) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | PSB-SC-01-0-1 | | | Brown f-c sand occ. gravel trace shell hash, glass fragments and brick fragments. (wet to moist) | <1 | NS | NO | 1 whole clam. no wood |
| 1 | | PSB-SC-01-1-2 archive | | | SAA. Grades from brown to tan in color. | <1 | NS | NO | no biota no wood |
| 2 | / | / | / | / | END OF EXPLORATION | / | / | / | / / / / |
| 3 | | | | | Predicted low-tide of 0.34-ft at 9:28PM (2128), based on NOAA Bellingham, WA Station ID 9449211 | | | | |
| 4 | | | | | Actual coordinates measured w/ Portable Trimble GPS, see attached table. | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

GeoEngineers

**Date:** 3/18/16 **Sample Start Time:** 2100 **End Time:** 2105

**Project:** R.G. Haley Supplemental Sediment Investigation

**Project Location:** Bellingham, WA **Project No:** 0356-114-06

**SEDIMENT CORE LOG:** PSB-SC-02 (Core Location)

| Mudline Elev: ~0.34 ft | Datum: NAVD 88 | Contractor: | Sample Method: | Sampling Equipment: TROWEL & SPOON | |
|---|---|---|---|---|---|
| Coordinates: | Datum: | Tube Length: Penetration Depth: 2' BML | OD/ID: Tube Material: | Logged by: CD | Checked by: |

| Total Core Depth | Core Interval | Interval Recovery | Sample Interval (ID) | Classification Symbol | Material/Lithology Description (color, material type, grain size, stratification, density, debris, etc.) | PID | Sheen | Odor | Vegetation/Biological Material–include type (sawdust, fibers, bark, chips, chunks, twigs, lumber, etc.) and amount of wood debris, by volume (none, <25%, 25-50%, >50%) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | PSB-SC-02-0-1 | | | Gray f-c sand w/ gravel, shell hash, glass fragments, and brick fragments. (wet) | <1 | NS | NO | no biota no wood |
| 1 | | PSB-SC-02-1-2 | | | Black f-m sand occ gravel trace shell hash, brick fragments (wet) | <1 | NS | SO | no biota no wood |
| | | | | | | slight odor of sulfur. | | | |
| 2 | | | | | END OF EXPLORATION | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

GEOENGINEERS

**Date:** 2/18/16 **Sample Start Time:** 2210 **End Time:** 2215

**Project:** R.G. Haley Supplemental Sediment Investigation

**Project Location:** Bellingham, WA **Project No:** 0356-114-06

**SEDIMENT CORE LOG:** PSB-SC-03 (Core Location)

| Mudline Elev: ~ 0.34 ft | Datum: NAVD 88 | Contractor: | Sample Method: | Sampling Equipment: TROWEL & SPOON | |
|---|---|---|---|---|---|
| Coordinates: | Datum: | Tube Length: Penetration Depth: 2' BML | OD/ID: Tube Material: | Logged by: CD | Checked by: |

| Total Core Depth (Depths to nearest 1/10 foot) | Core Interval | Interval Recovery | Sample Interval (ID) | Classification Symbol | Material/Lithology Description (color, material type, grain size, stratification, density, debris, etc.) | PID/Sheen/Staining (none, slight, moderate, heavy) PID | Sheen | Odor | Vegetation/Biological Material–include type (sawdust, fibers, bark, chips, chunks, twigs, lumber, etc.) and amount of wood debris, by volume (none, <25%, 25-50%, >50%) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | PSB-SC-03-0-1 | | Brow to gray f-c sand w/ gravel, glass fragments, brick fragments and shell hash (wet) | <1 | NS | NO | no biota no wood |
| 1 | | | PSB-SC-03-1-2 | | SAA | <1 | NS | NO | no biota no wood |
| 2 | / | / | / | / | END OF EXPLORATION | / | / | / | / / / / |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

GEOENGINEERS

**Date:** 2/18/16 **Sample Start Time:** 2140 **End Time:** 2145

**Project:** R.G. Haley Supplemental Sediment Investigation

**Project Location:** Bellingham, WA **Project No:** 0356-114-06

**SEDIMENT CORE LOG:** PSB-SC-04 (Core Location)

| Mudline Elev: ~0.34-ft Datum: NAVD88 | Contractor: | Sample Method: | Sampling Equipment: TROWEL & SPOON | |
|---|---|---|---|---|
| Coordinates: Datum: | Tube Length: Penetration Depth: | OD/ID: Tube Material: 2' BML | Logged by: CD | Checked by: |

| Total Core Depth | Core Interval | Interval Recovery | Sample Interval (ID) | Classification Symbol | Material/Lithology Description (color, material type, grain size, stratification, density, debris, etc.) | PID | Sheen | Odor | Vegetation/Biological Material– include type (sawdust, fibers, bark, chips, chunks, twigs, lumber, etc.) and amount of wood debris, by volume (none, <25%, 25-50%, >50%) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | PSB-SC-04-0-1 | | Brown to gray f-c sand w/ gravel, glass fragments, brick fragments and shell hash. (wet) | <1 | NS | NO | no biota no wood |
| 1 | | | PSB-SC-04-1-2 archive | | SAA. | | | | |
| 2 | | | | | END OF EXPLORATION | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

Depths to nearest 1/10 foot

GEOENGINEERS

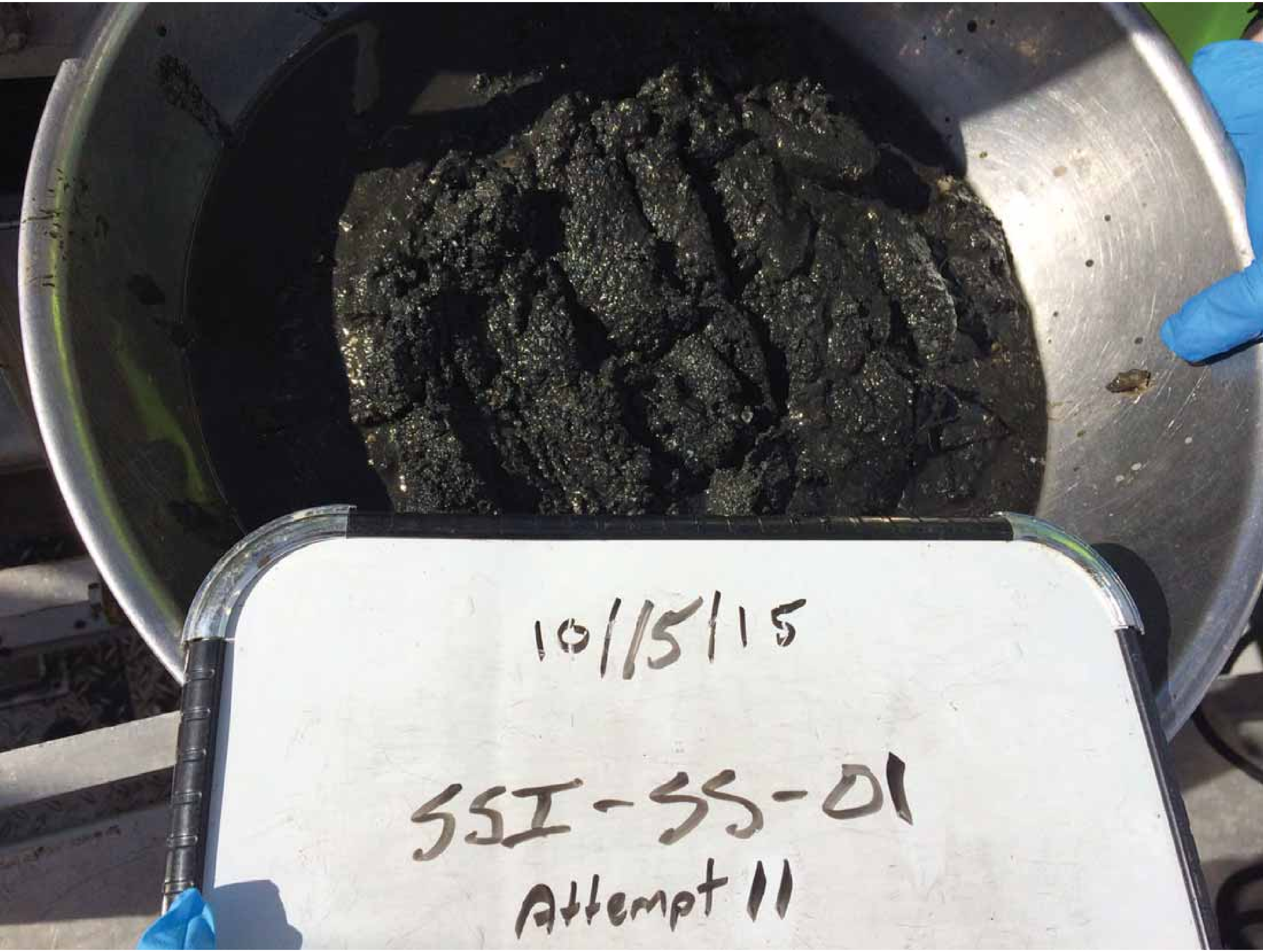
**Date:** 2/18/16 **Sample Start Time:** 2125 **End Time:** 2120

**Project:** R.G. Haley Supplemental Sediment Investigation

**Project Location:** Bellingham, WA **Project No:** 0356-114-06

# APPENDIX B
## Photographs

# B.1 Supplemental Sediment Investigation
# Surface - 2015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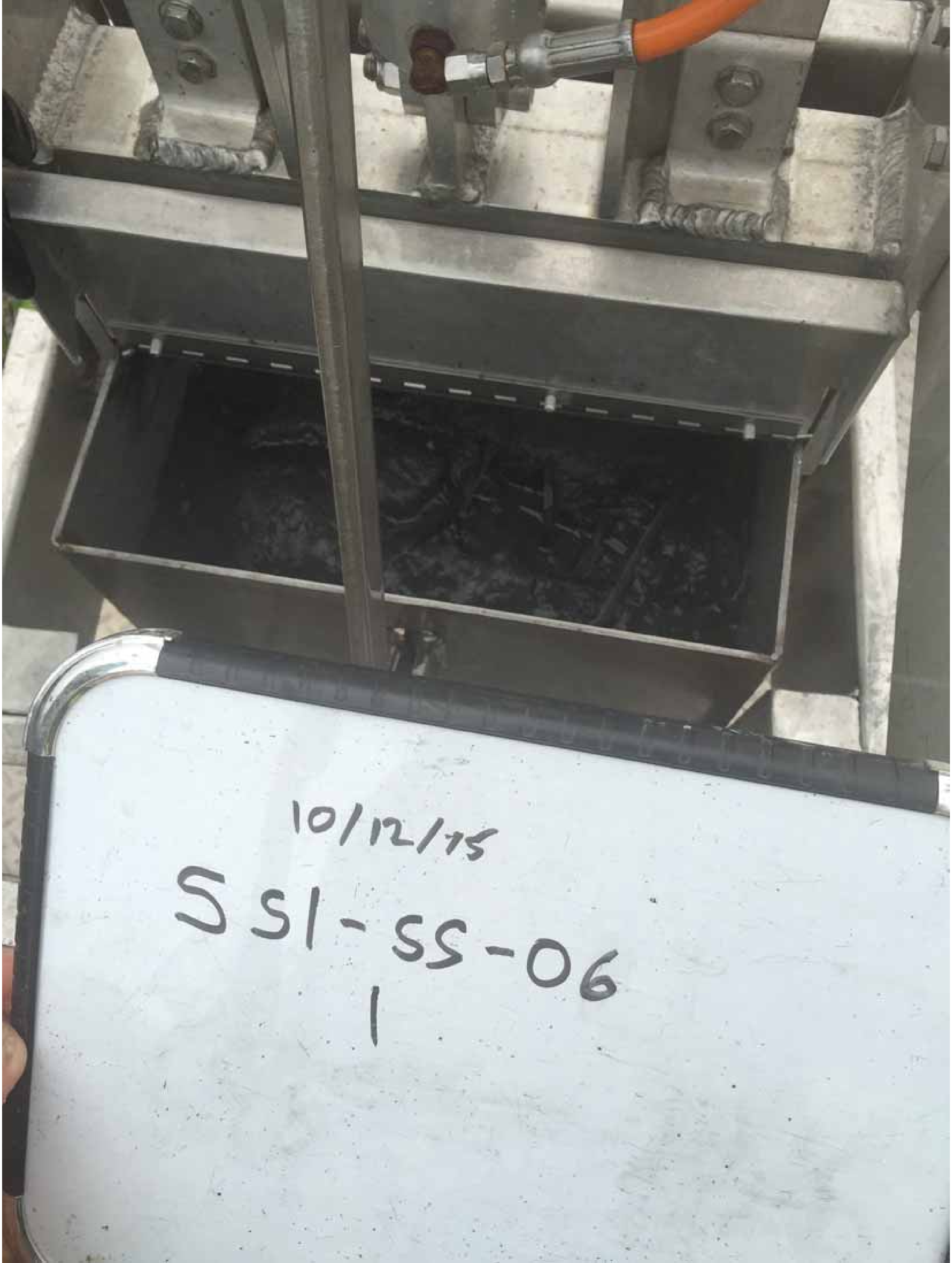
10/15/15
SS1-S
02


10/13/15
SS1-SS-03
3


10/15/15
SS1-SS-04


10/12/15
SS1-SS-05
1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10/12/15
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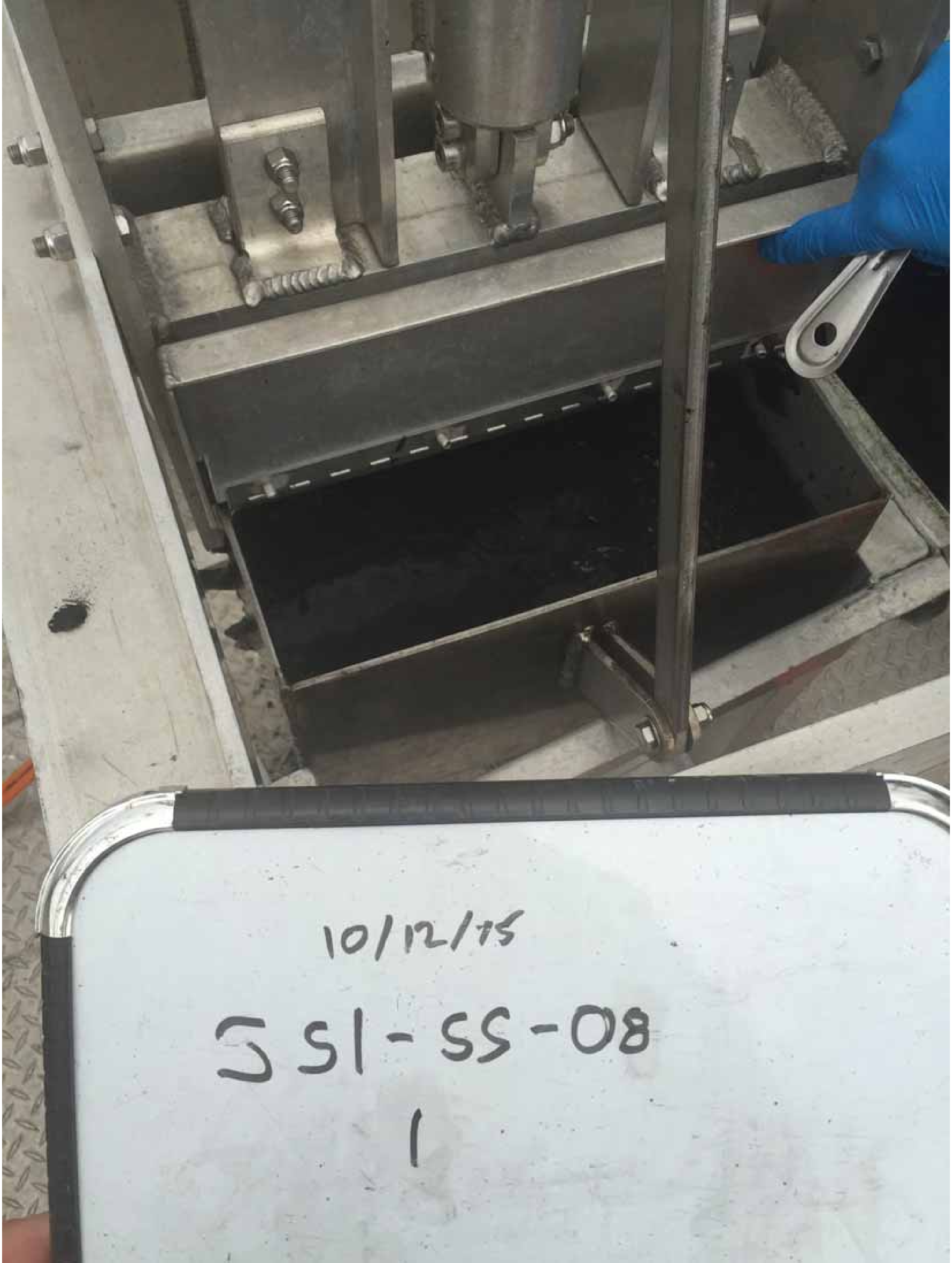
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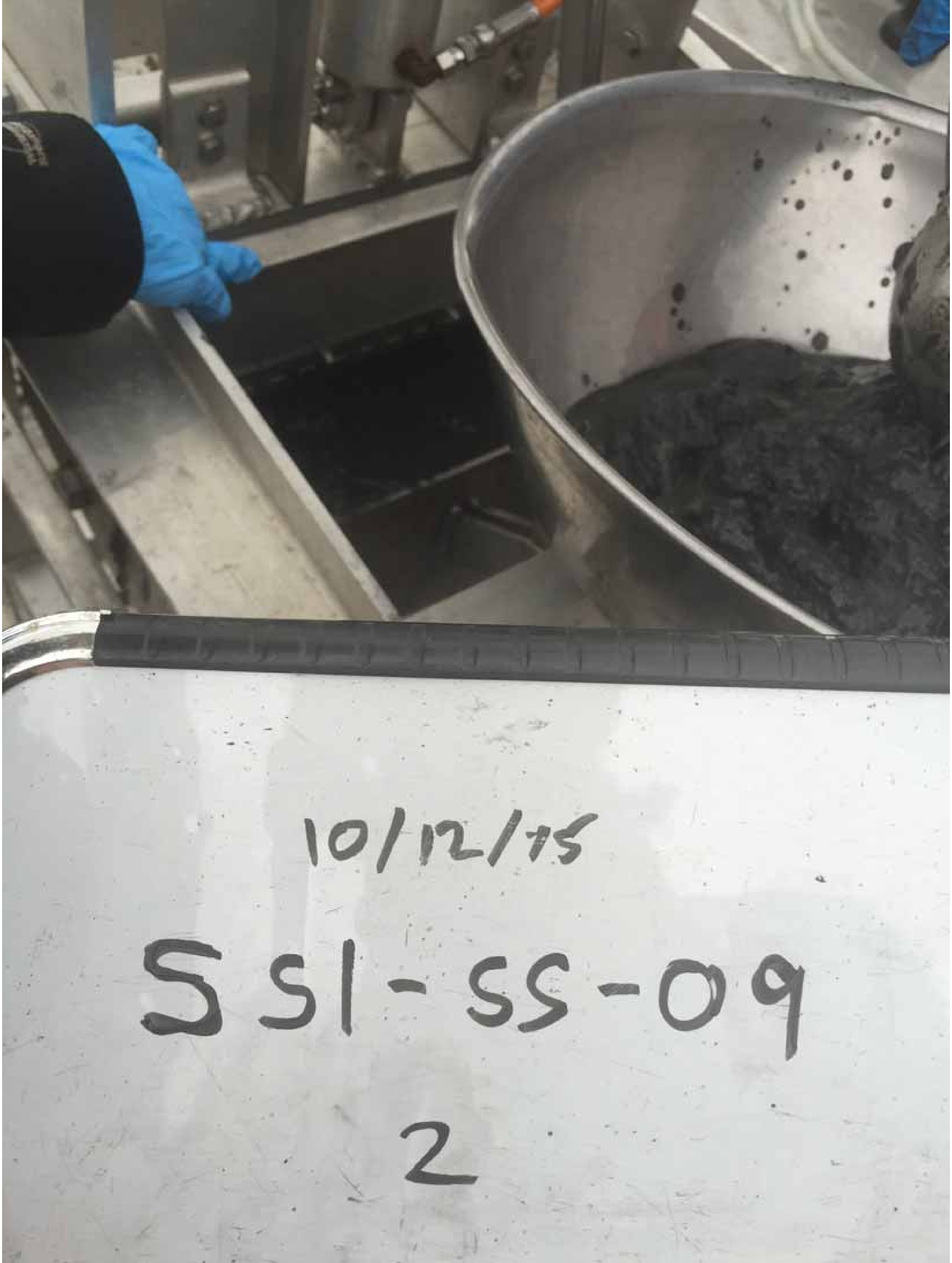
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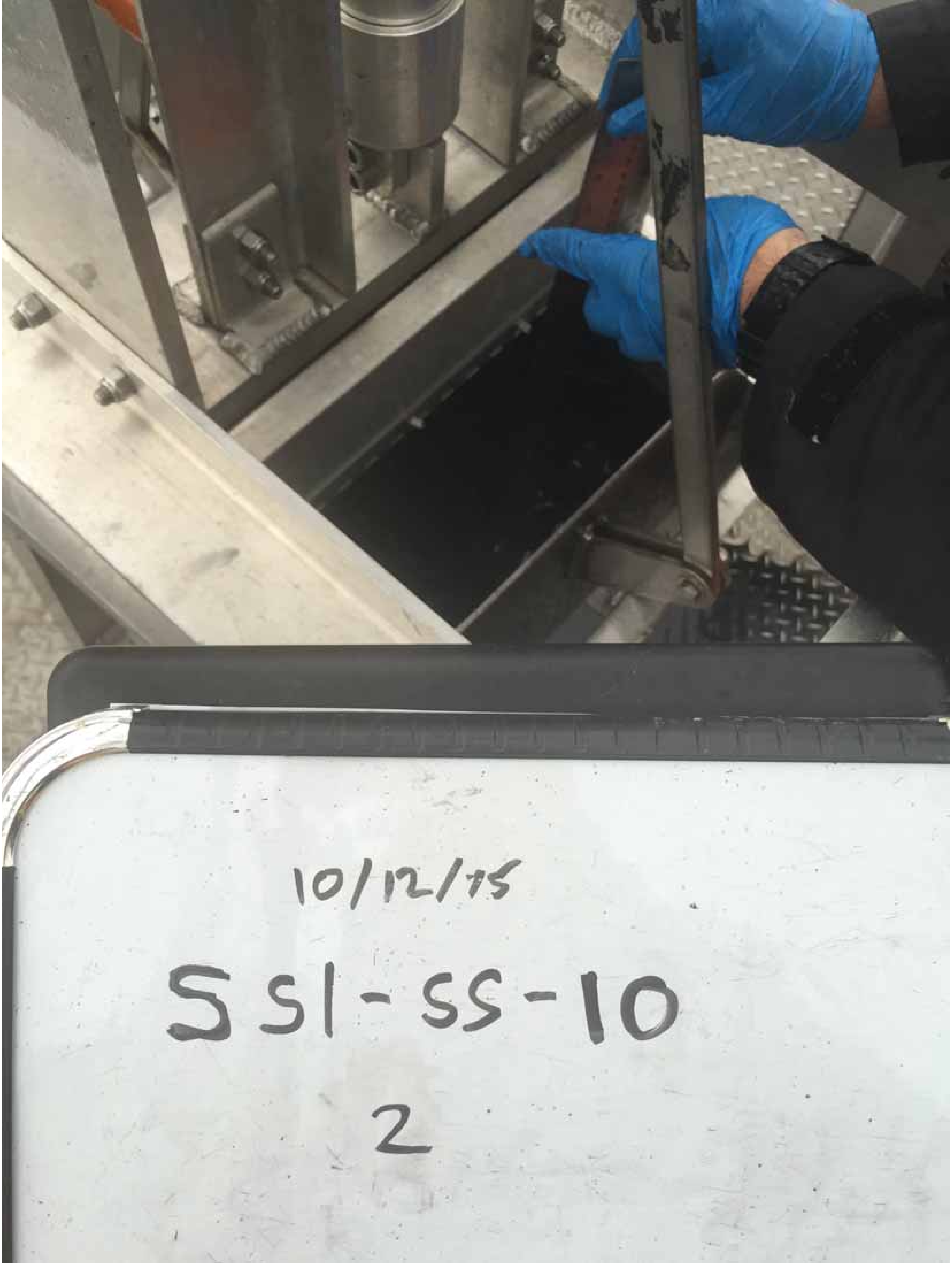
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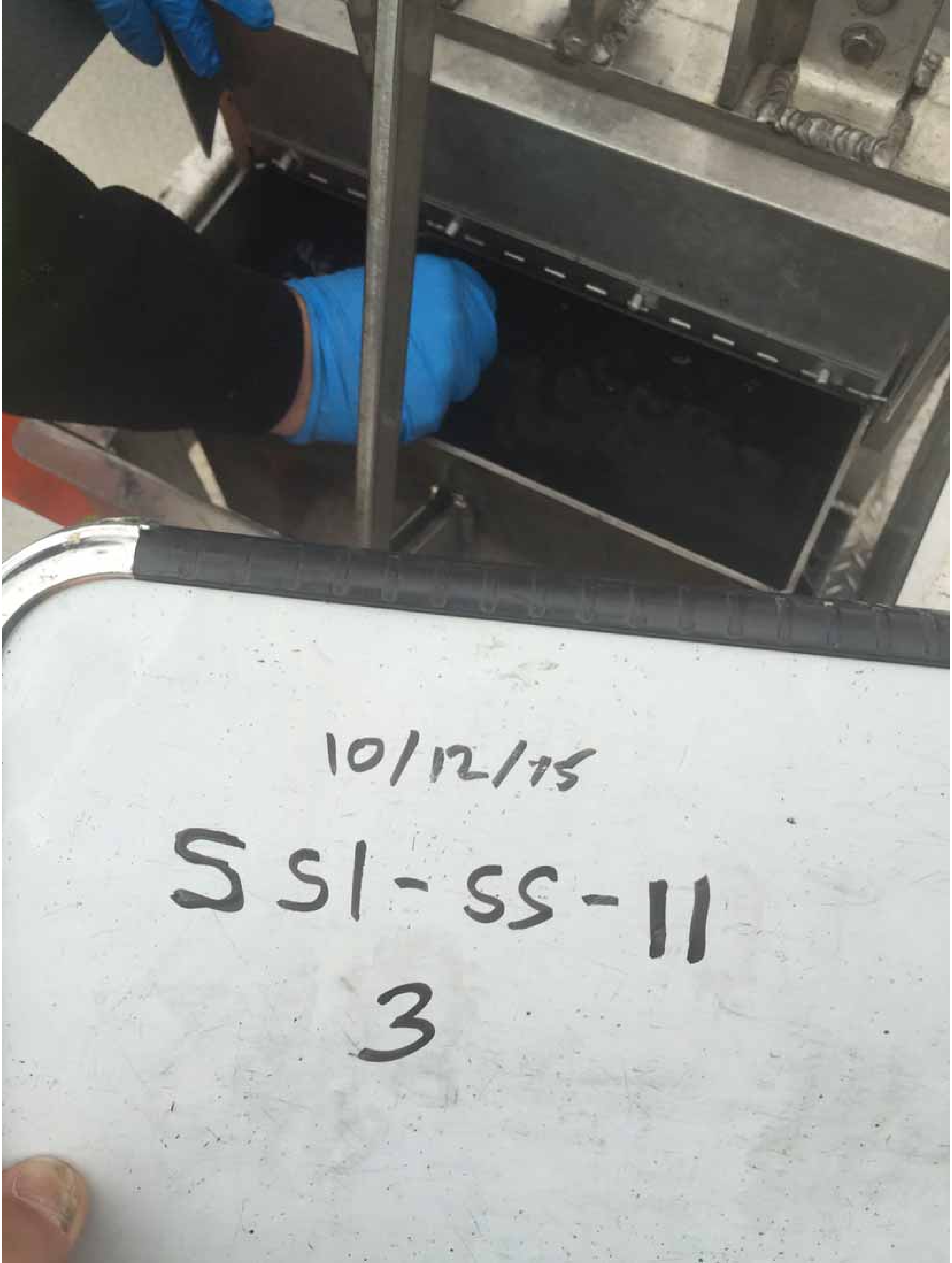
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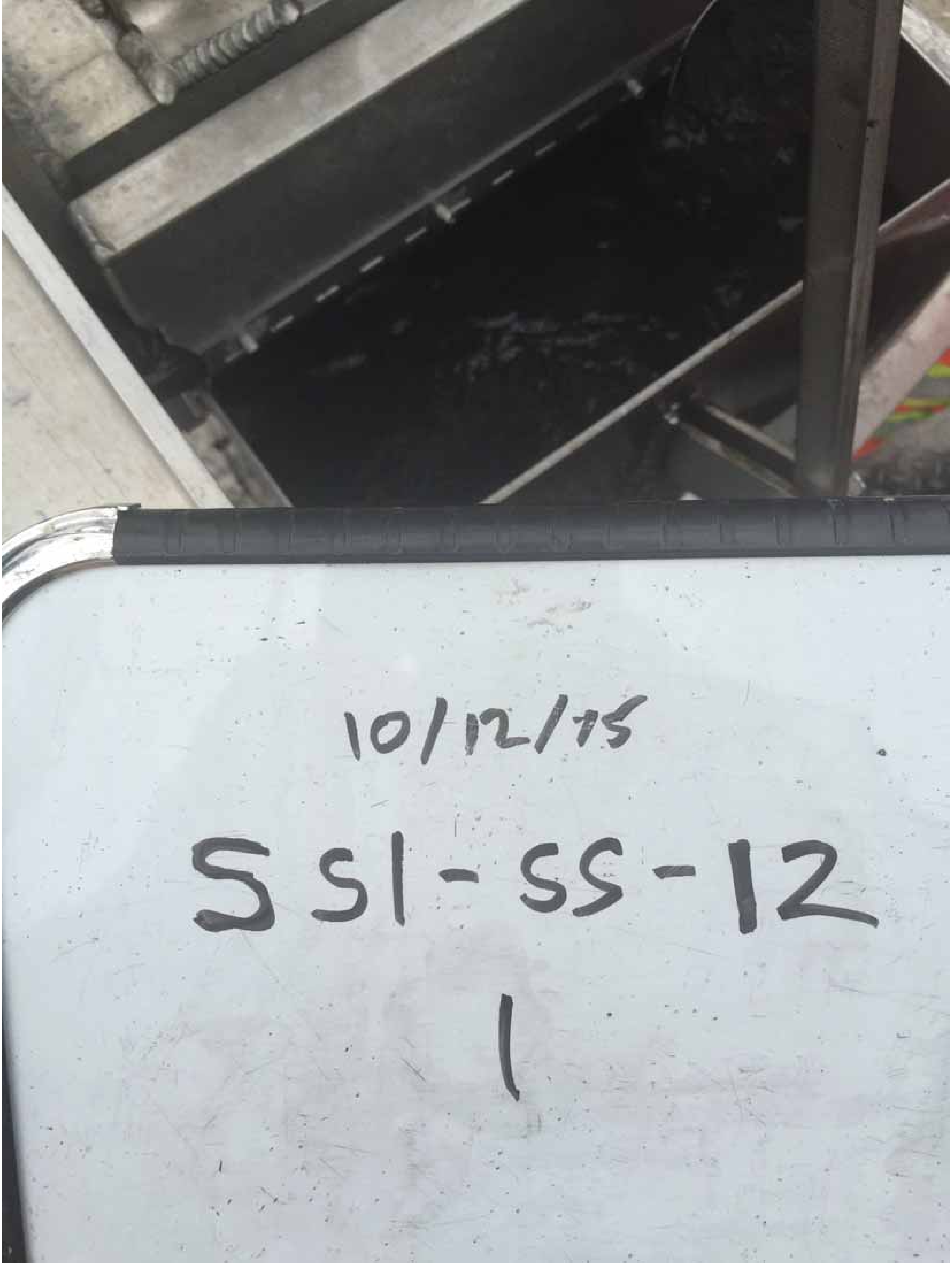
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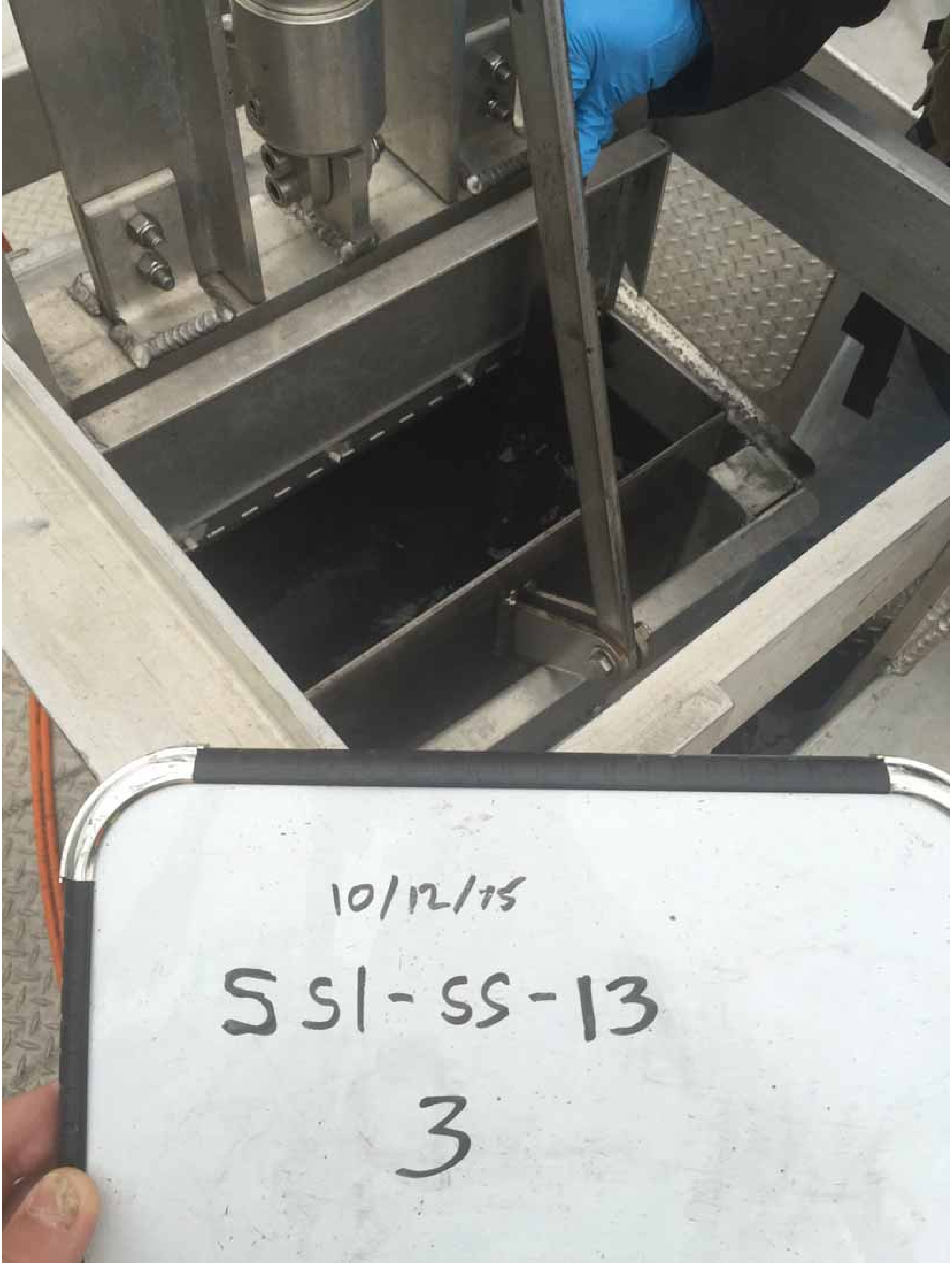
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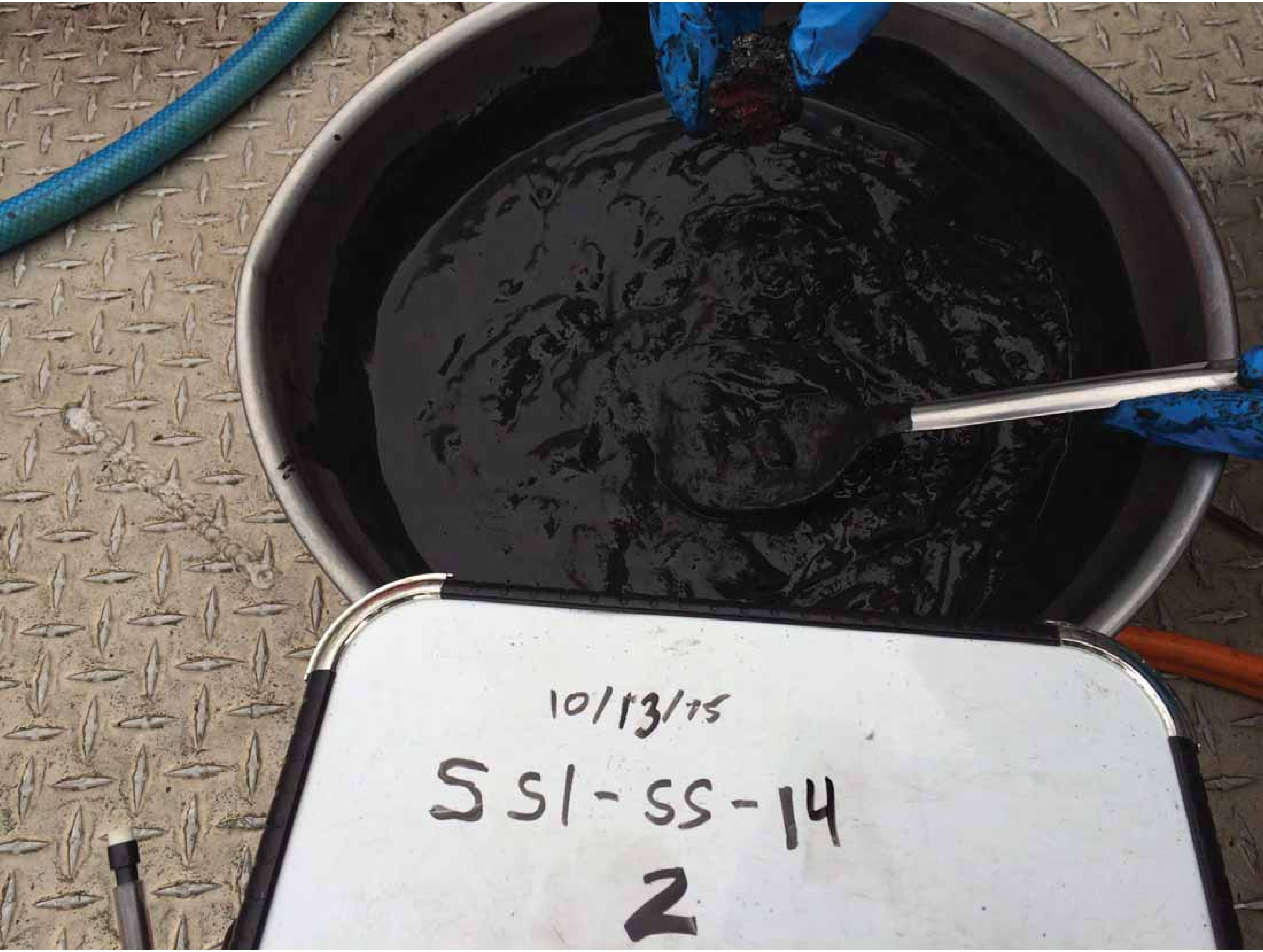
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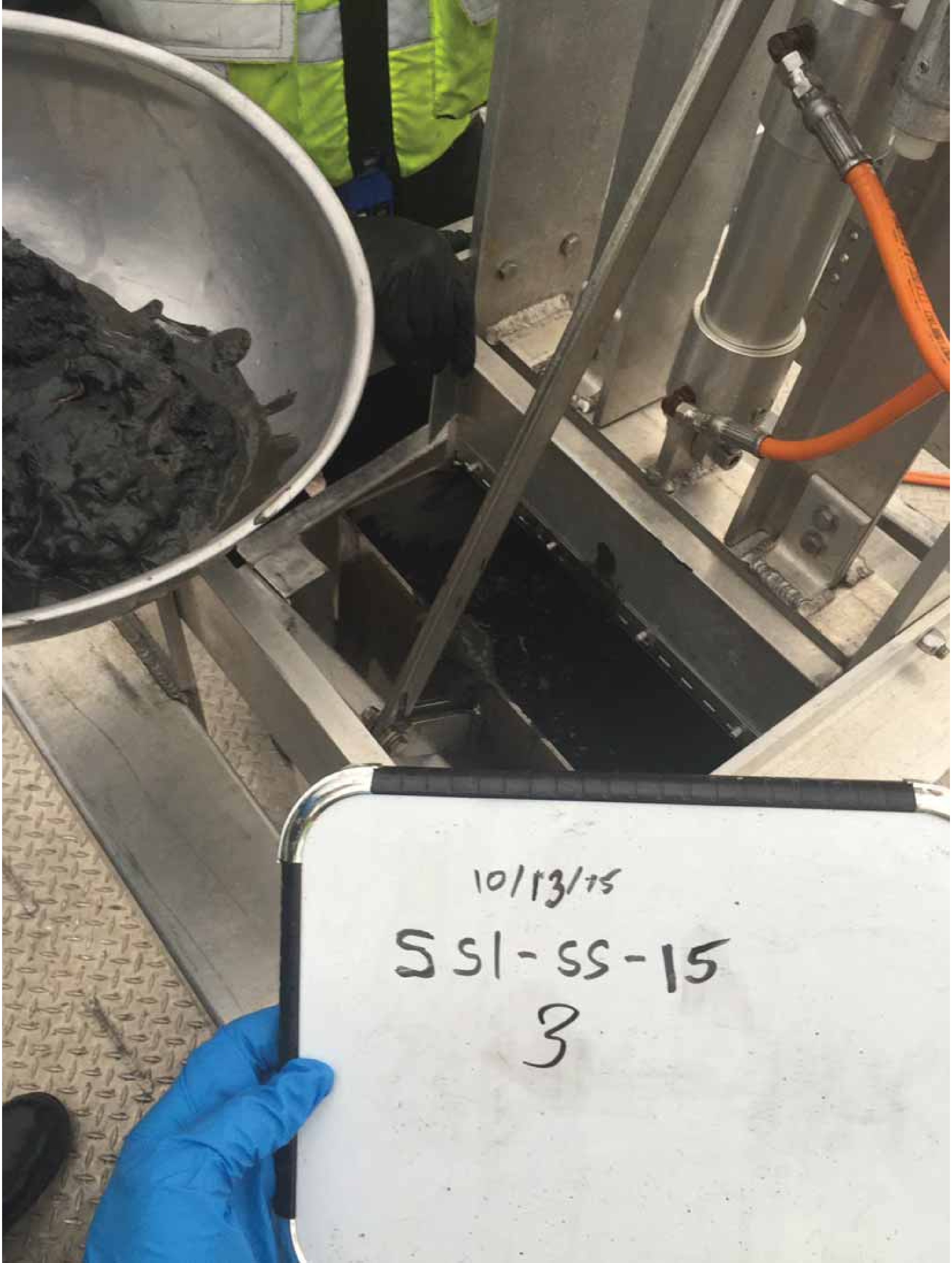
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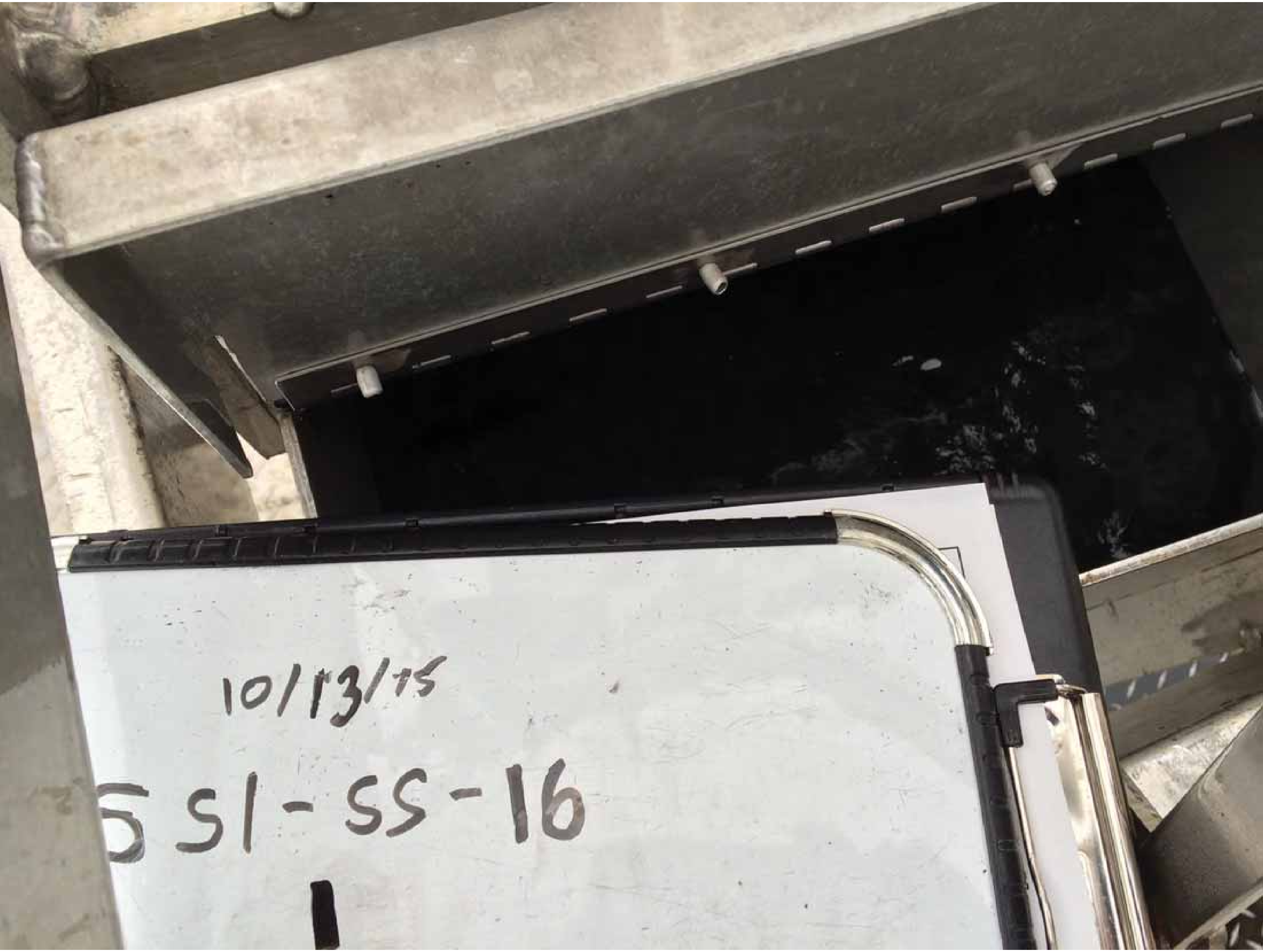
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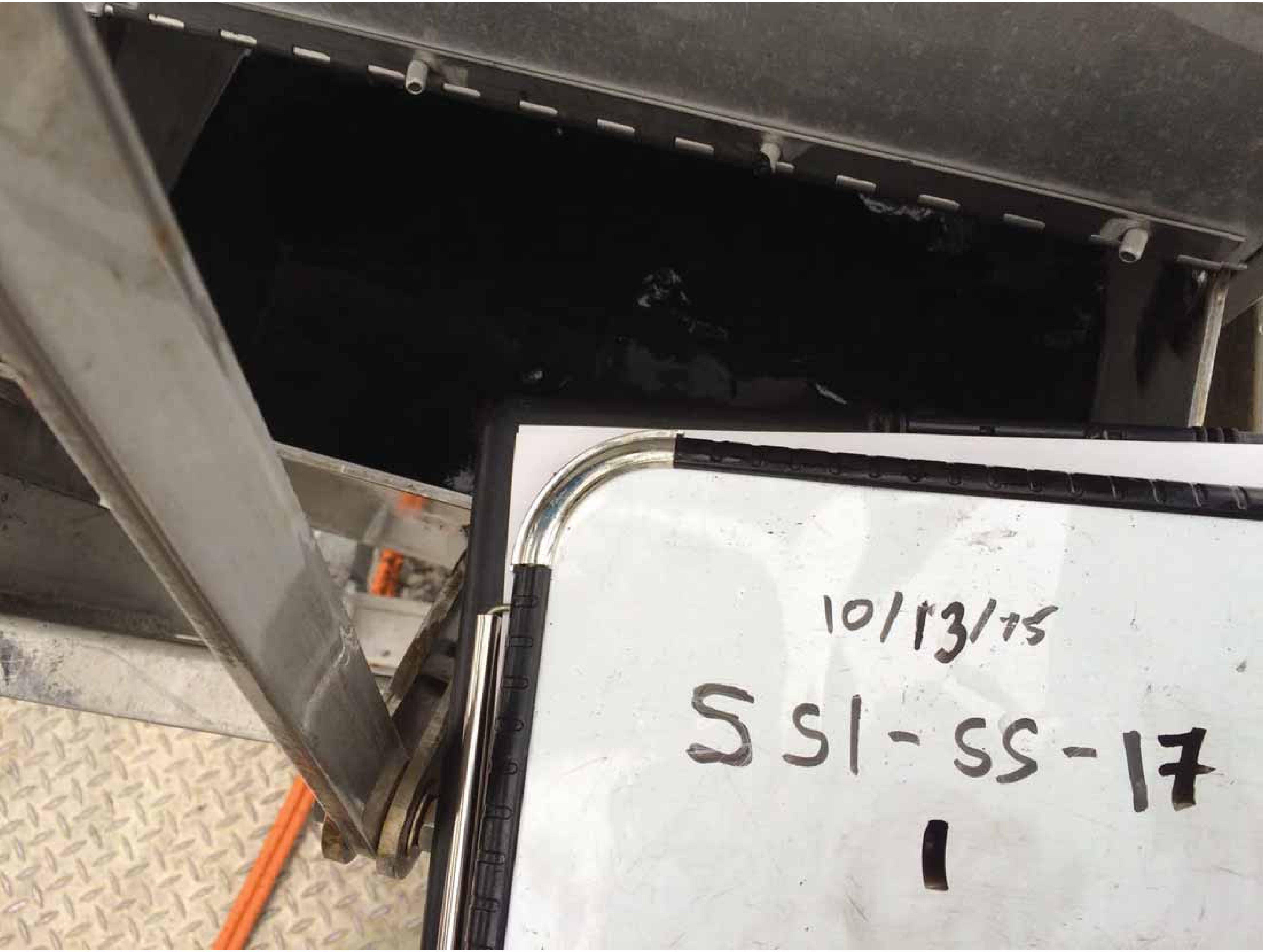
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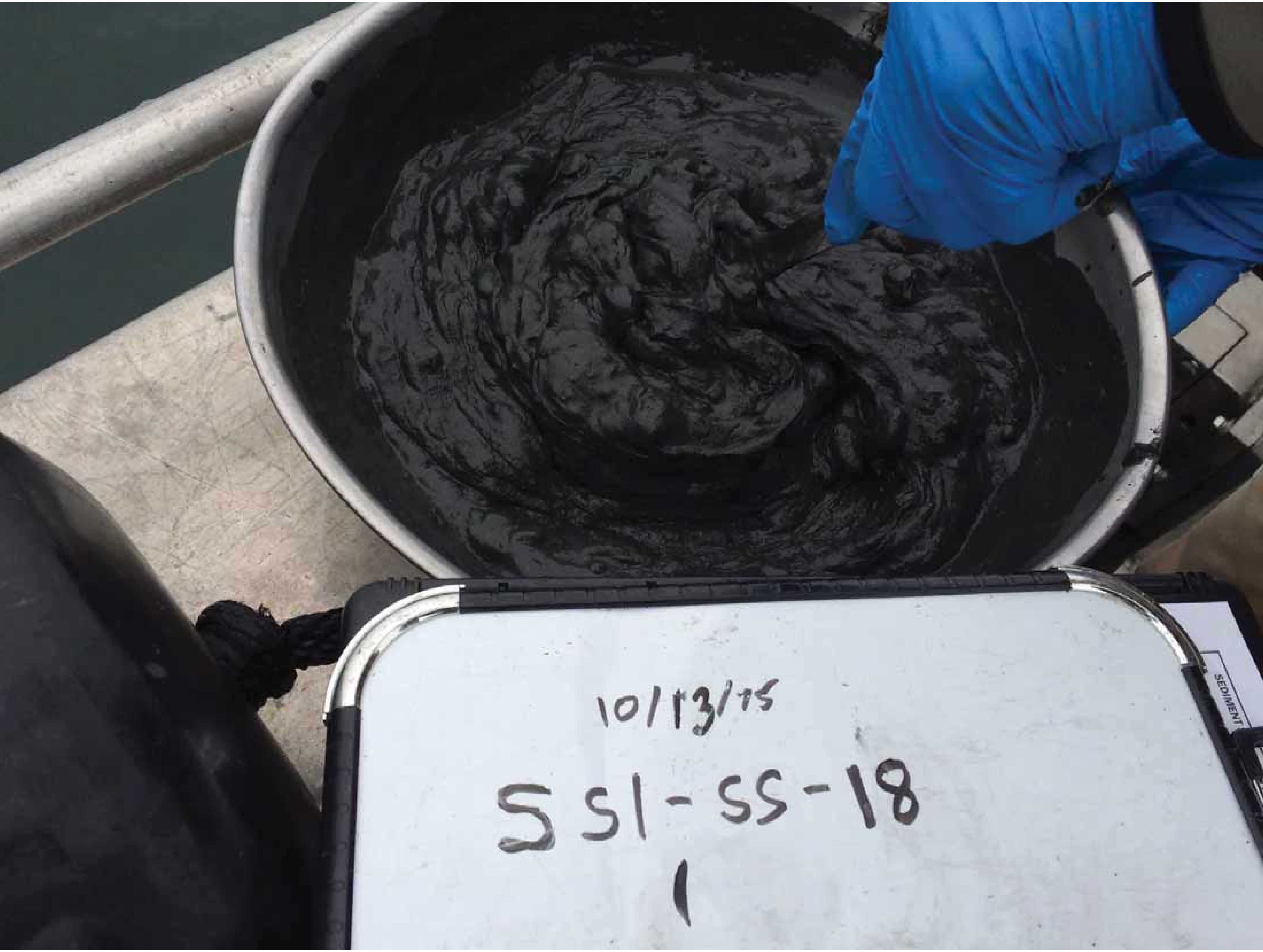
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SEDIMENT

# B.2 Supplemental Sediment Investigation Suburface - 2015


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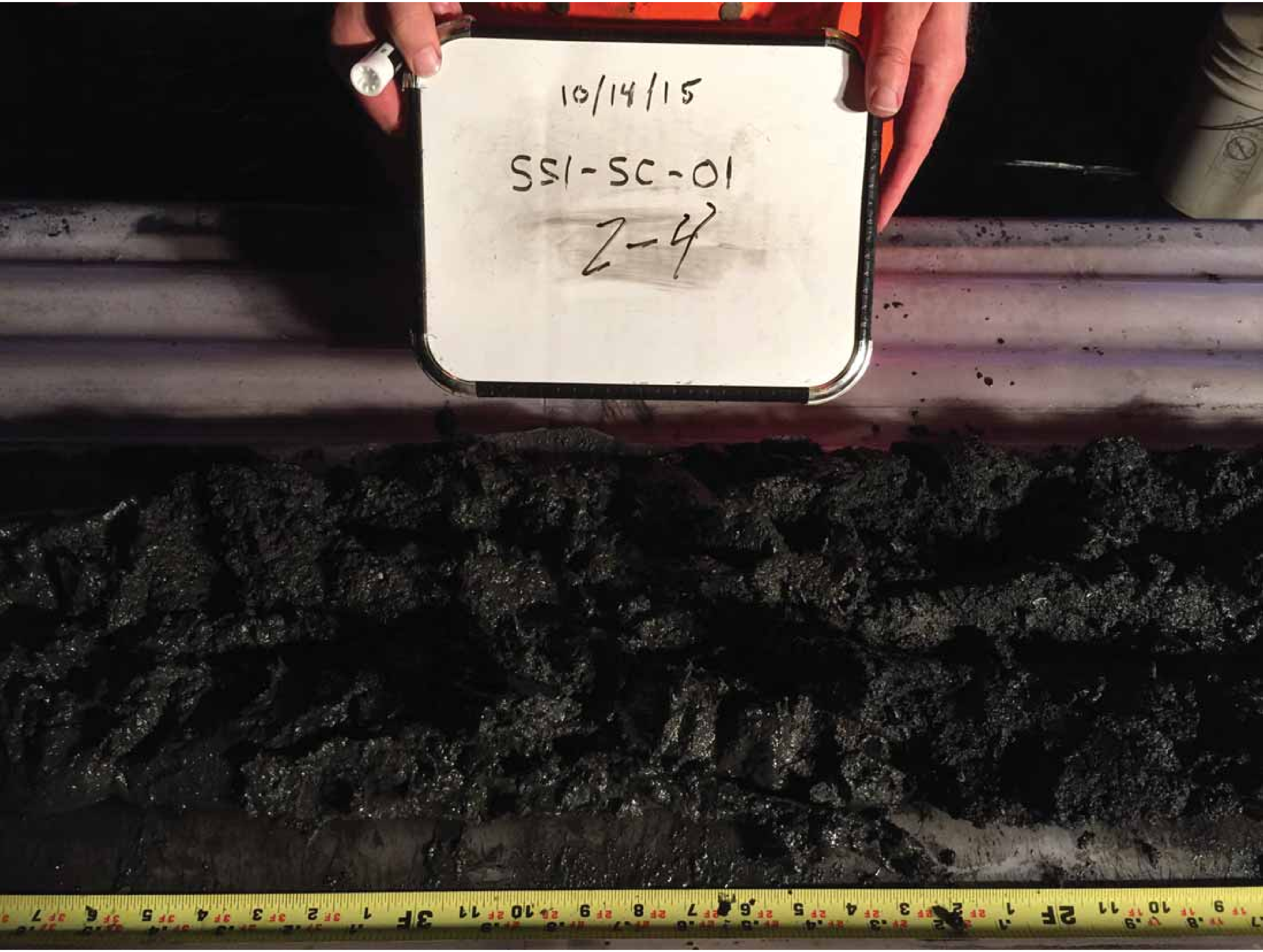
D-2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2-4


10/14/15
SS1-SC-01
4-6


10/14/15
SS1-SC-03
0-2'


10/14/15
SS1-SC-03
2-4


10/14/15
SS1-SC-03
4-6


10/14/15
SS1-SC-03
6-8
EXPO
low odor


10/15/15
SS1-SC-04
0-2'


10/15/15
SS1-SC-04
2-4'
PALRUF


SSI-SC-05
0-2'
(0-1.5')


10/13/15
SS1-SC-05
2-4
(1.5-3')

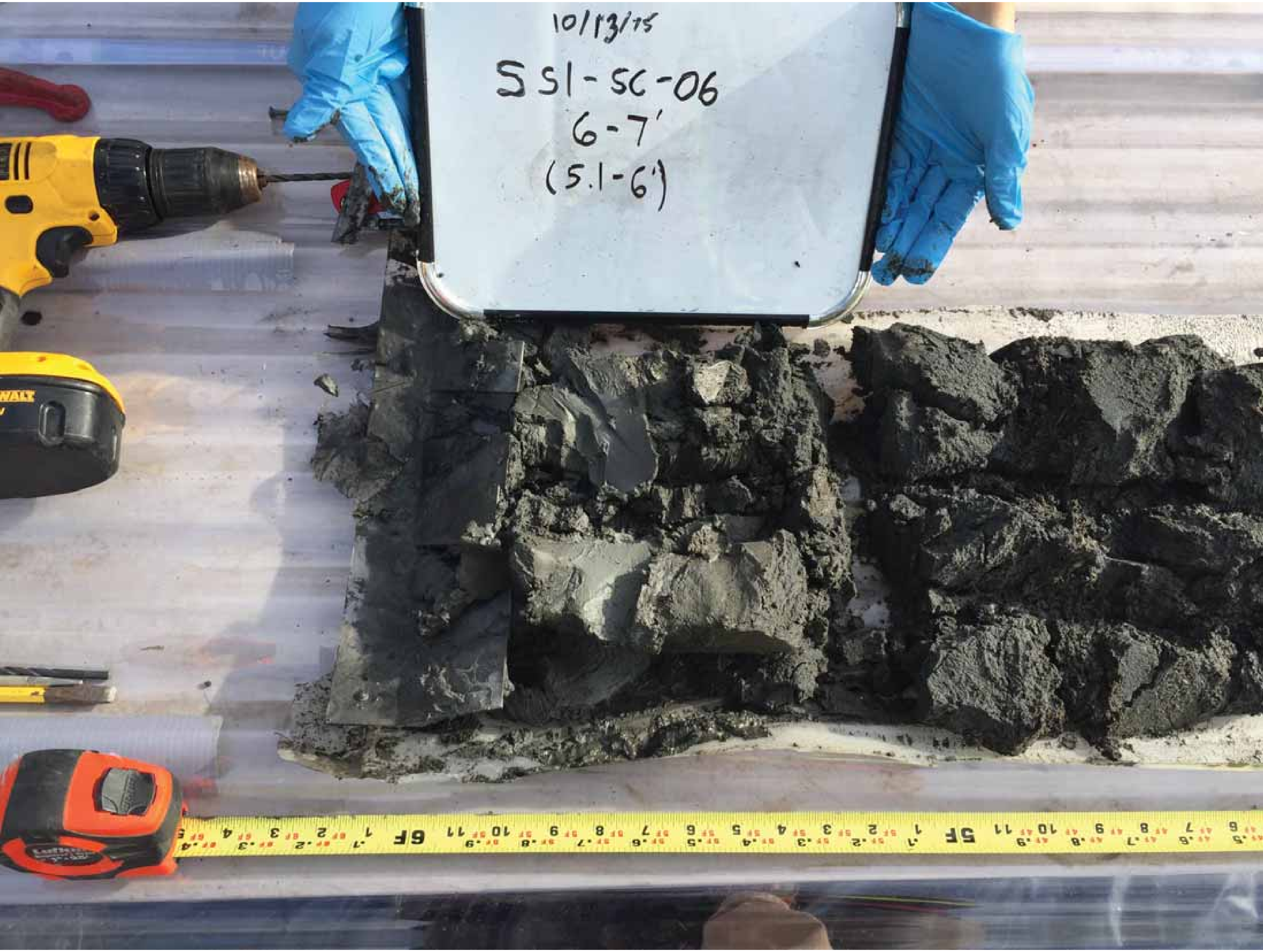

10/13/15
SS1-SC-05
4-6
(3-4.5)


SS1-SC-05
6-8
(4.5-6)


10/13/15
SS1-SC-06
0-2'
(0-1.7)


10/13/15
SS1-SC-06
2-4'
(1.7-3.4')


10/13/15
SS1-SC-06
4-6'
(3.4-5.1')


10/13/15
SS1-SC-06
6-7'
(5.1-6')

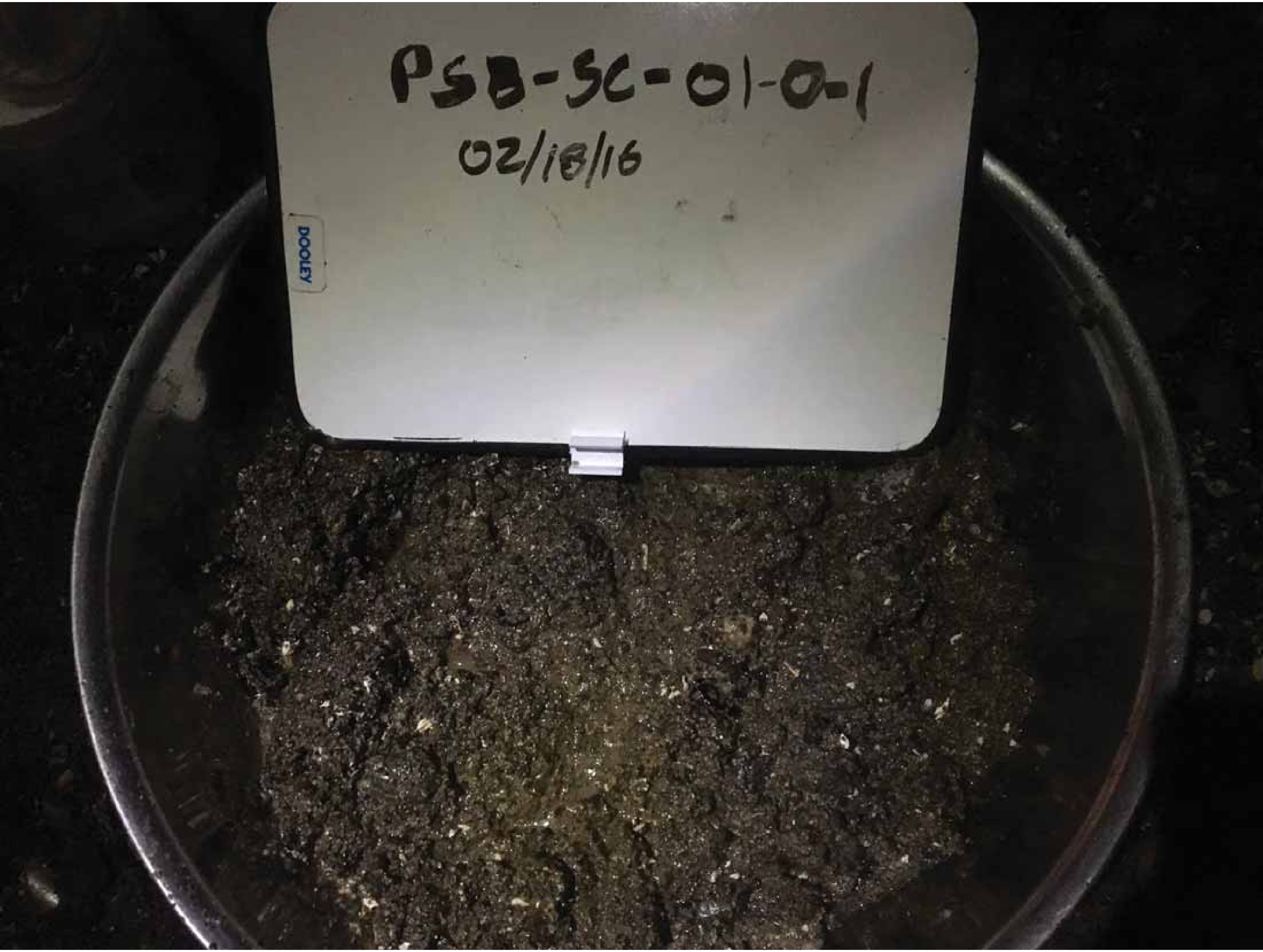

10/13/15
SS1-SC-07
0-2'
(0-2')

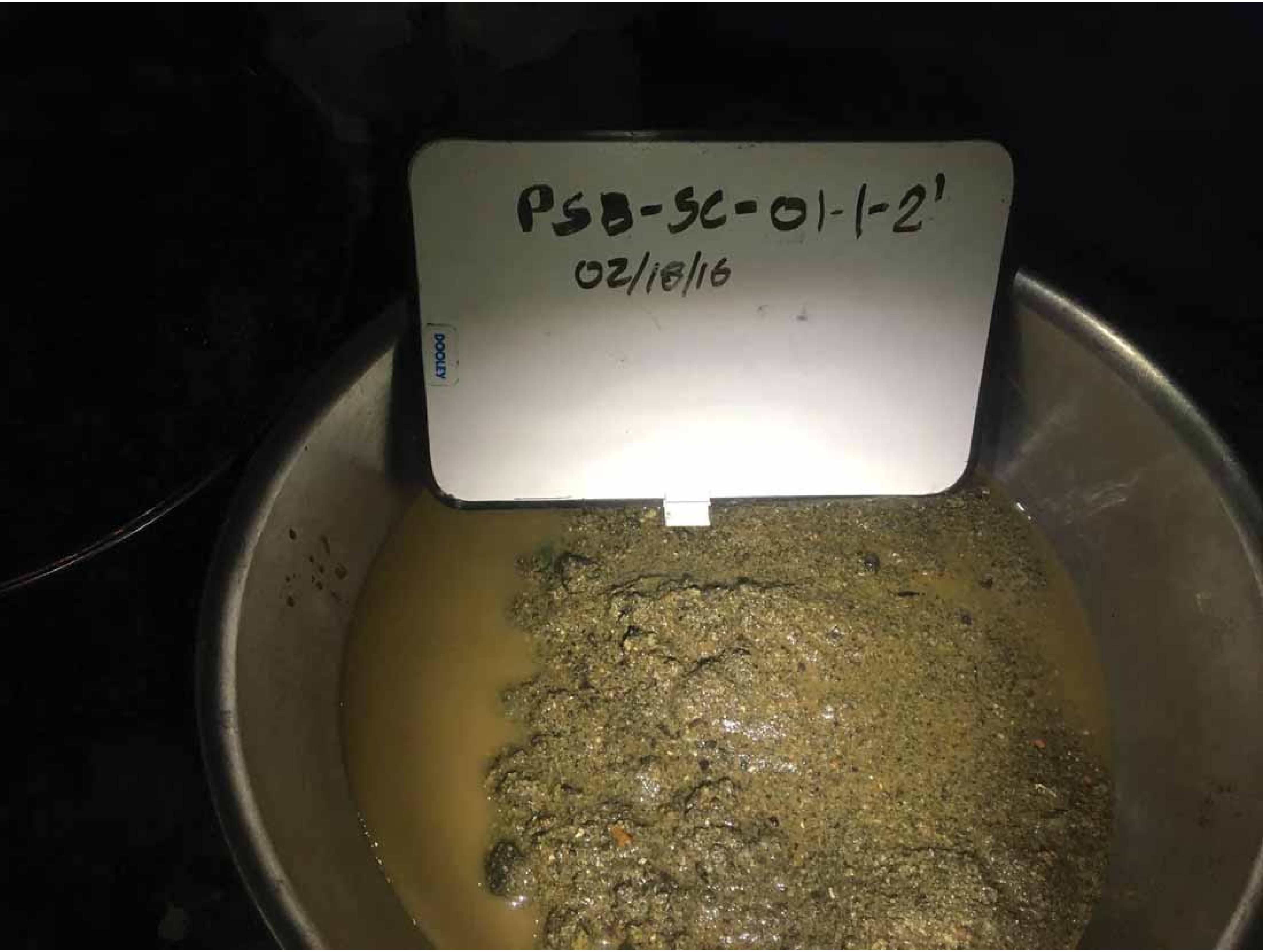

10/13/15
SS1-SC-07
2-4'
(2-4)


10/13/15
SSI-SC-07
4-6'
(4-6')


SS1-SC-07
6-8'
(6-8')

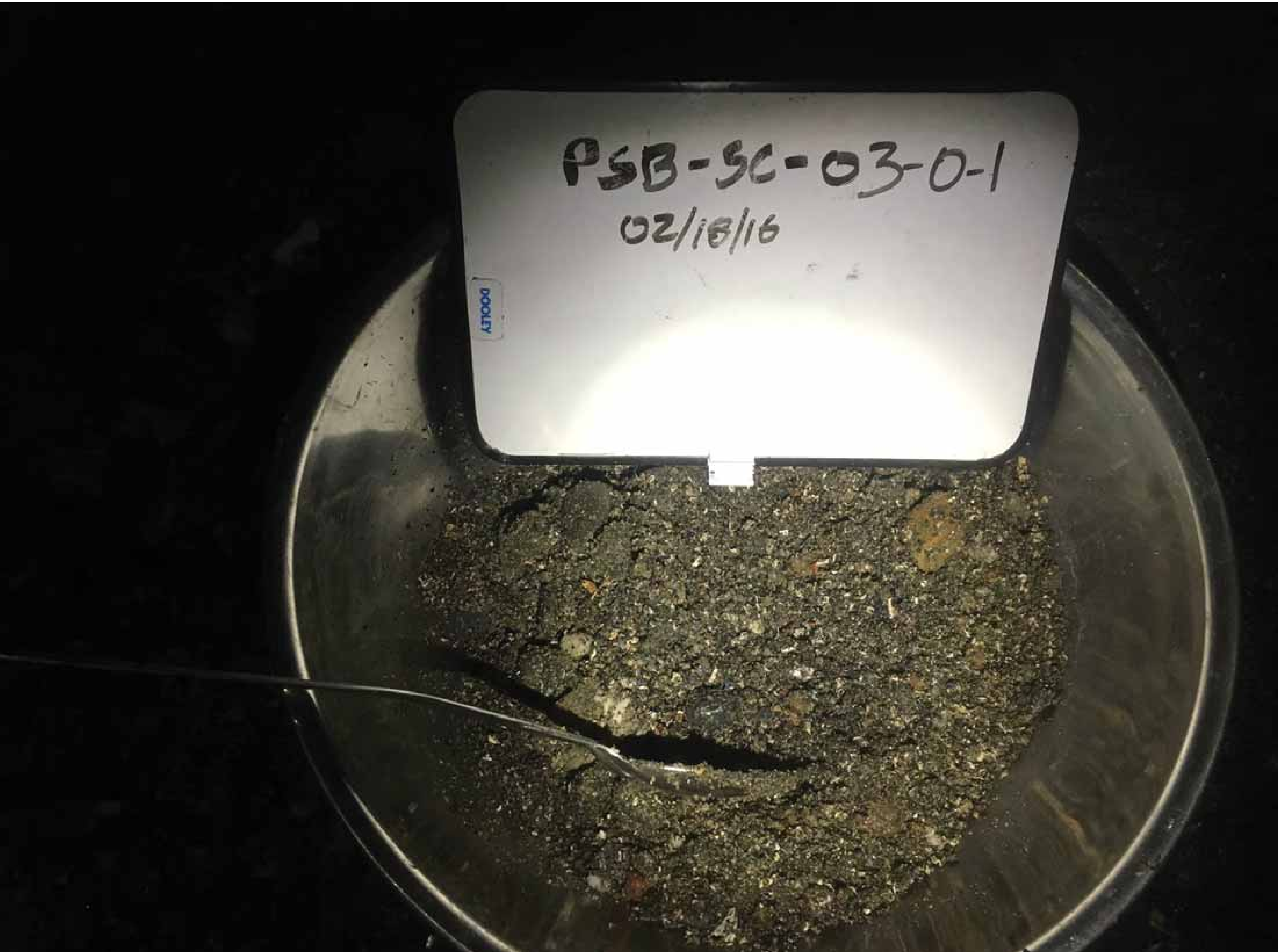
## B.3 Pine Street Beach
## Surface - 2016

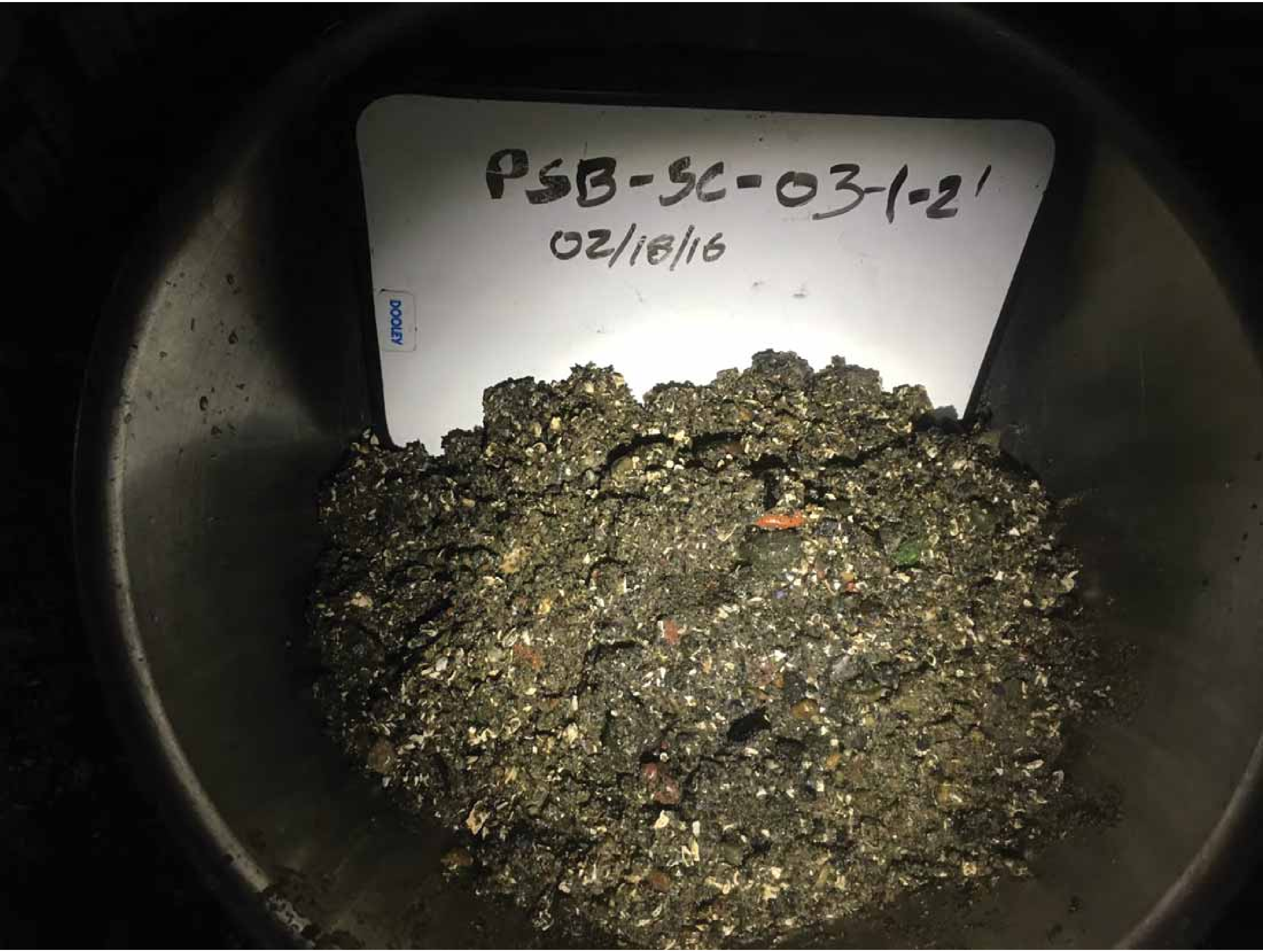

PSB-SC-01-0-1
02/18/16
DOOLEY

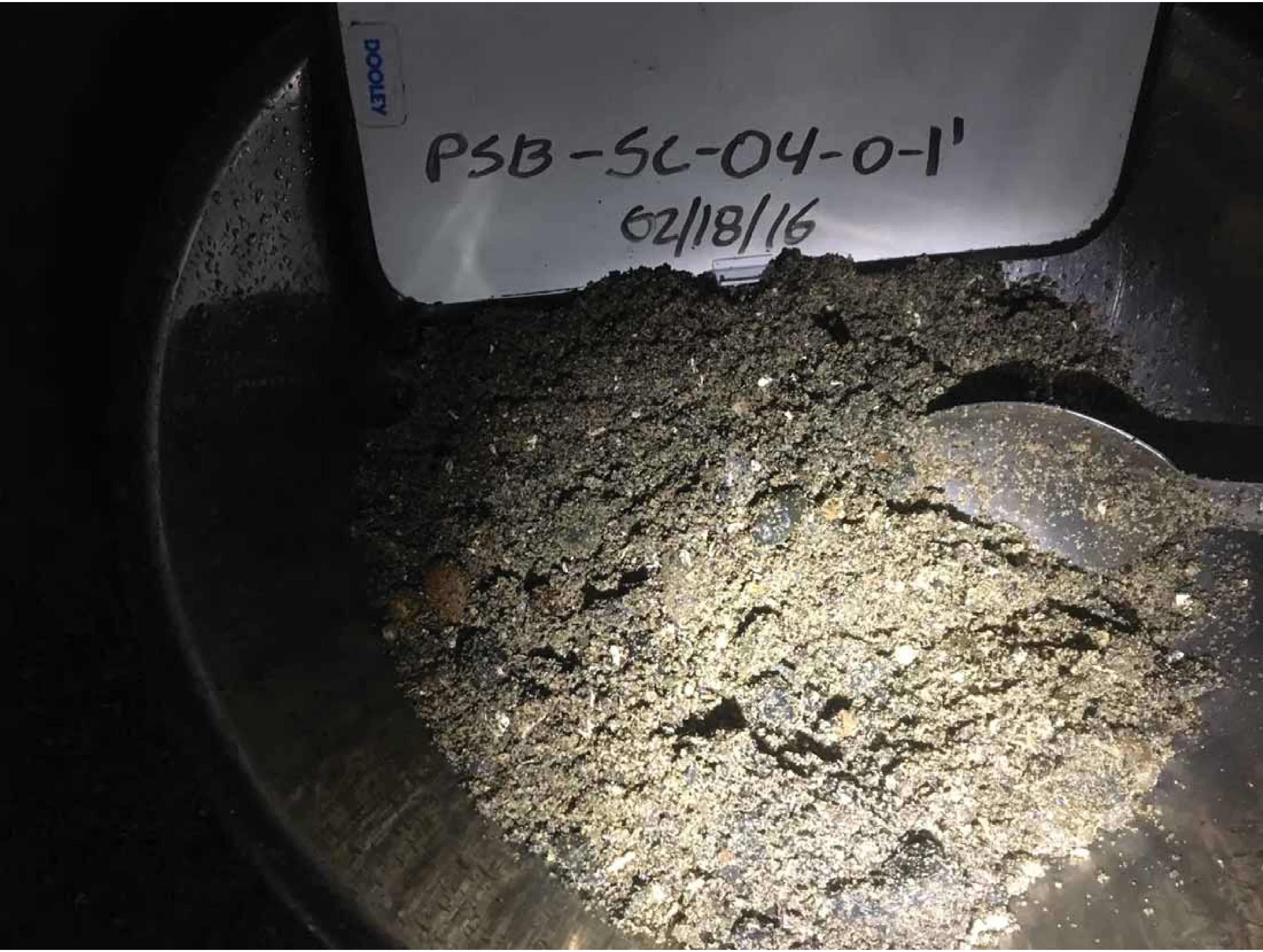

PSB-SC-01-1-2'
02/18/16
DOOLEY

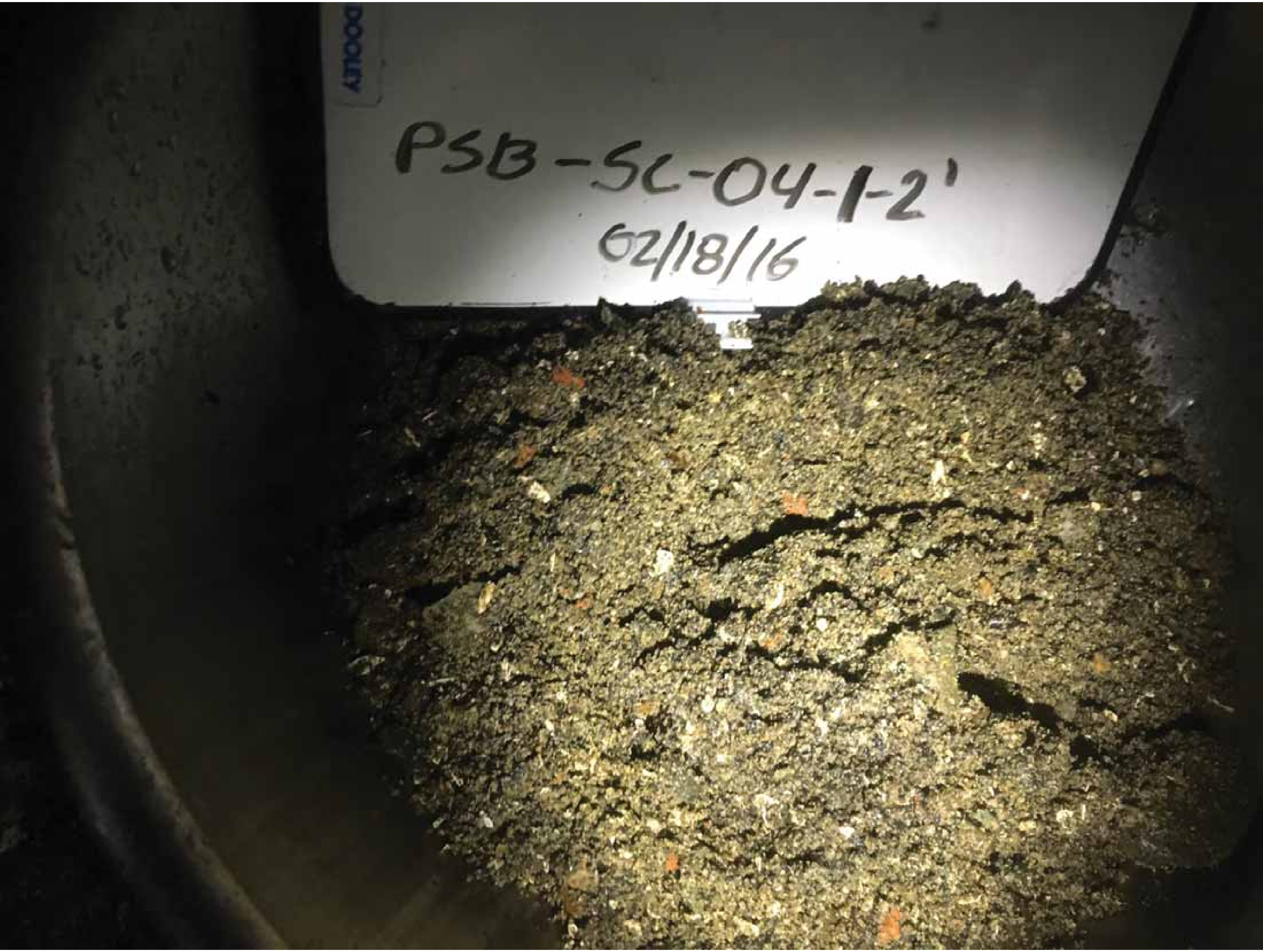

PSB-SC-02-0-1'
02/18/16


DOOLEY
PSB-SC-02-1-2'
02/18/16


PSB-SC-03-0-1
02/18/16
DOOLEY


PSB-SC-03-1-2'
02/18/16
DOOLEY


DOOLEY
PSB-SC-04-0-1'
02/18/16


PSB-SC-04-1-2'
02/18/16

# APPENDIX C
## Data Validation Reports

# APPENDIX C
# DATA VALIDATION SUMMARY

## Chemical

Data validation of all sediment data derived from the SSI was performed primarily by GeoEngineers, Inc. (GeoEngineers). However, a set of three sample delivery groups (SDGs) for dioxins/furans collect in 2015 were validated by EcoChem, Inc. Data validation was conducted on all data points originating from the laboratory analytical program activities. As prescribed by this program, the Data Quality Objectives (DQO) established in the SAP were used to assess precision, accuracy, representativeness, completeness, and comparability parameters. Accuracy for all SSI samples was acceptable, as demonstrated by the laboratory control sample and matrix spike and matrix spike duplicate (MS/MSD) percent recovery values. Precision was acceptable, as demonstrated by the MS/MSD and laboratory duplicate relative percent difference (RPD) values, or absolute difference values when appropriate. Laboratory representativeness was acceptable as the correct laboratory methods and sample holding times were met. The laboratory completeness goal of 90 percent was fulfilled, as all of the data points were considered valid after the validation process. Comparability of sampling methods and laboratory methods for this data set relative to previously collected RI data were deemed acceptable and appropriate.

The U.S. Environmental Protection Agency (EPA) defines the requirements for various levels of validation. Validation was conducted in accordance with EPA's Contract Laboratory Program National Functional Guidelines for organics (EPA 2008) and dioxins/furans (EPA 2011). An EPA-defined Stage 2B validation was conducted on 100 percent of the data points. An EPA-defined Stage 4 level validation was conducted on the largest SDG, or 10 percent of the data points. No internal laboratory transcription errors were found through the validation process and all data points were deemed acceptable for their intended use. More detailed descriptions of the qualified data points are available in Attachments C-1 and C-2.

## Biological

Bioassay test results were validated by reviewing protocol, test conditions and parameters, results of the reference toxicity test, control and reference performance, and checking endpoint calculations provided in Ramboll's bioassay report (Appendix E). Tests were performed according to protocol, with a few minor exceptions. Temperature and salinity were slightly elevated in the amphipod bioassay (the maximum test temperature was 16.5°versus a maximum 16°as called for in the protocol; a test salinity maximum was 30 parts per thousand (ppt) versus 29 ppt as an upper limit in the protocol). The polychaete bioassay also experienced salinities greater than the upper limit (29 ppt) specified in the protocol (salinity on one or more days was measured at 31 ppt or 32 ppt in all samples). These minor deviations did not adversely affect the performance of these two bioassays, as demonstrated by the control, reference and test responses.

Reference toxicity tests were within the ranges reported by the lab during prior tests, indicating that test organisms were of similar sensitivity as previously tested batches of organisms. Control and reference test results for all bioassays were within the limits required for use in endpoint calculations and evaluations. A subset (approximately 10 percent) of endpoints were recalculated; no errors were discovered. Bioassay results were suitable for site-specific decisions regarding risks to the benthic community and site cleanup.

# C.1 Data Validation Report – GeoEngineers, Inc.

# Data Validation Report

Plaza 600 Building, 600 Stewart Street, Suite 1700, Seattle, Washington 98101, Telephone: 206.728.2674, Fax: 206.728.2732 www.geoengineers.com

**To:** RG Haley Supplemental Investigation and Revised RI

**File:** 00356-114-06

**Date:** January 8, 2018

This report documents the results of a U.S. Environmental Protection Agency (EPA)-defined Stage 2B and Stage 4 data validation (EPA Document 540-R-08-005; EPA 2009) of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples collected as part of the 2015 RG Haley Supplemental Sediment Investigation sampling event, located in Bellingham Bay.

This sampling event involved taking sediment cores from Bellingham Bay and dividing each core into representative depths that would characterize the extent of contamination in the Bay. Each core depth was documented in a chain-of-custody (COC) and sent to a laboratory for storage and/or analysis in the form of labeled sample containers, along with the COC requesting specific analysis by the laboratory (First Round Analyses). Some samples were requested to be immediately archived, or stored at -20 degrees Celcius in a freezer, until further analytical requests could be made by GeoEngineers. These archived requests (Second and Third Round Analyses) would be based on site information to be obtained from the First Round Analyses data set.

The validation of the analytical suites that involve High Resolution/Mass Spectrometry (dioxins/furans by Method 1613B) in the First Round Analyses as the validation of this analytic method was performed by a third party validator. The findings of this validation are reported in a separate memo prepared by EcoChem, Inc. (Attachment C-2). However, any validation of Method 1613B of the Second and Third Round Analyses are included in this memo.

Also included in this memo are three sediment samples that were collected by Landau Associates (labeled in Table 1-A).

## OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008), the National Functional Guidelines for Inorganic Superfund Data Review (EPA 2014), and the EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (EPA, 2011) in order to determine if the laboratory analytical results meet the project specific objectives and are usable for their intended purpose. Data usability was assessed by evaluating if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Quality Assurance Project Plan (Appendix B of the Final Work Plan, Supplemental Sediment Investigation; GeoEngineers, 2015), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method Blanks
- Laboratory Control Samples (LCS)
- Field Duplicates
- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)
- Miscellaneous
- Reporting Limits

## VALIDATED SAMPLE DELIVERY GROUPS

Data validation included review of the sample delivery groups (SDGs) listed below in Table 1-A.

**TABLE 1-A: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS**

| Primary SDG | Samples Validated |
|---|---|
| **AHU9** | CL-SG-3_0-0.33 and CL-SG-4_0-0.33<br>(Samples were collected by Landau Associates for dioxins/furans only) |
| **AKF6** | CL-SG-1_0-0.33<br>(Samples were collected by Landau Associates for dioxins/furans only) |
| **AOL1**<br>**(Level 4 validation)** | SSI-SS-05_0-0.39, SSI-SS-06_0-0.39, SSI-SS-07_0-0.39, SSI-SS-08_0-0.39, SSI-SS-09_0-0.39, SSI-SS-10_0-0.39, SSI-SS-11_0-0.39, SSI-SS-12_0-0.39, Rinseate-151012 |
| **AOM9** | SSI-SC-05_0-2, SSI-SC-05_2-4, SSI-SC-06_0-2, SSI-SC-06_2-4, SSI-SC-07_0-2, SSI-SC-DUP-04, SSI-SC-07_2-4, and Rinsate_151013 |
| **AOR4** | SSI-SC-01_0-2, SSI-SC-DUP-01, SSI-SC-01_2-4, SSI-SC-03_0-2, SSI-SC-03_2-4, and Rinseate-151014 |
| **AOS3** | SSI-SS-01_0-0.39, SSI-SS-DUP-03, SSI-SS-03_0-0.39, SSI-SC-04_0-2, SSI-SC-DUP-03, and SSI-SC-04_2-4 |
| **AOS6** | SSI-SS-02_0-0.39 and SSI-SS-04_0-0.39 |
| **AUJ6** | SSI-SC-05_4-6, SSI-SC-06_4-6, and SSI-SC-06_4-6 |
| **AWM5** | SSI-SS-09_0-0.39 (Pentachlorophenol ONLY) |

| Primary SDG | Samples Validated |
|---|---|
| **AWJ5** | PSB-SC-01_0-1, PSB-SC-02_0-1, PSB-SC-02_1-2, PSB-SC-03_0-1, PSB-SC-03_1-2, and PSB-SC-04_0-1 |
| **9350** | SSI-SS-14_0-0.39, SSI-SS-15_0-0.39, and SSI-SS-16_0-0.39 |
| **9351 (Level 4 Validation)** | SSI-SS-08_0-0.39, SSI-SS-10_0-0.39, SSI-SS-11_0-0.39, SSI-SS-12_0-0.39 (Validated by EcoChem) |
| **9353** | SSI-SC-05_4-6, SSI-SC-06_4-6, and SSI-SC-07_4-6 (Validated by GeoEngineers) SSI-SC-03_0-2, SSI-SC-03_2-4, SSI-SC-05_0-2, SSI-SC-05_2-4, SSI-SC-06_0-2, SSI-SC-06_2-4, SSI-SC-07_0-2, SSI-SC-07_2-4, and SSI-SC-DUP-04 (Validated by EcoChem) |
| **9354** | SSI-SC-01_0-2, SSI-SC-01_2-4, SSI-SC-04_0-2, SSI-SC-04_2-4, SSI-SC-DUP-01, SSI-SC-DUP-03 (Validated by EcoChem) |
| **9571** | SSI-SS-02_0-0.39 |
| **9648** | PSB-SC-01_0-1, PSB-SC-02_0-1, PSB-SC-02_1-2, PSB-SC-03_0-1, PSB-SC-03_1-2, and PSB-SC-04_0-1 |

## CHEMICAL ANALYSIS PERFORMED

Analytical Resources, Inc. (ARI), located in Tukwila, Washington, performed laboratory analysis on the sediment samples using one or more of the following methods:

- Total solids by Standard Method 2540G
- Total organic carbon by SW9060M
- Total petroleum hydrocarbons by NWTPH-Dx (Silica Gel treated)
- Semivolatile organic compounds (SVOCs) by Method SW8270D
- Polycyclic aromatic hydrocarbons (PAHs) and four other selected semivolatiles (PAHs) by Method SW8270-SIM
- Pentachlorophenol by Method SW8041 (SW8270-SIM with clean-up if matrix interference was encountered)
- Tetra through octa-chlorinated dioxins and furans by Method 1613B

Frontier Analytical Laboratory (Frontier) located in El Dorado Hills, California, performed laboratory analysis on the sediment samples using the following methods:

- Tetra through octa-chlorinated dioxins and furans by Method 1613B

The following Sample Delivery Groups (SDGs) were validated by EcoChem, Inc. in Seattle, Washington. The validation report/memo is provided as an attachment to Appendix C of the data report.

**TABLE 1-B: SUMMARY OF SUB-CONTRACTED VALIDATION SAMPLE DELIVERY GROUPS**

| Primary SDG | Samples Validated |
|---|---|
| **9351** | SSI-SS-08_0-0.39, SSI-SS-10_0-0.39, SSI-SS-11_0-0.39, and SSI-SS-12_0-0.39 |
| **9353** | SSI-SC-03_0-2 , SSI-SC-03_2-4, SSI-SC-05_0-2 , SSI-SC-05_2-4, SSI-SC-06_0-2, SSI-SC-06_2-4, SSI-SC-07_0-2, SSI-SC-07_2-4, and SSI-SC-DUP-04 |
| **9354** | SSI-SC-01_0-2, SSI-SC-01_2-4, SSI-SC-04_0-2, SSI-SC-04_2-4, SSI-SC-DUP-01, and SSI-SC-DUP-03 |

## DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

### Data Package Completeness

ARI provided the required deliverables for data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and identified anomalies were discussed in the relevant laboratory case narrative.

### Chain-of-Custody Documentation

Chain-of-custody (COC) forms were originally filled out by GeoEngineers or Landau Associates and were provided with the laboratory analytical reports in the same data package along with pertinent email communications. The COCs were accurate, appropriately signed, and complete when submitted to the lab.

All samples were archived at the laboratory upon receipt.

### Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for all chemical analyses. The sample coolers arrived at the laboratory at the appropriate temperatures of between 2 and 6°C, with the exceptions below:

**SDG AOM9:** One out of six sample coolers was recieved by the laboratory with a temperature reading of 7.2°C. As the sample coolers were received on the same day as they were sent from GeoEngineers, no action was taken for this outlier.

Upon arrival at both laboratories, each sediment sample was stored in a freezer at -20°C in case any would be requested for analysis after a first-round assessment was completed by GeoEngineers and Ecology.

### Surrogate/Labeled Compound Recoveries

A surrogate or a labeled compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in any environmental sample. Surrogates are used for organic analyses and are added to all samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. All surrogate percent recoveries for field samples were within the laboratory control limits, with the following exceptions:

**SDG AOL1:** (SIM-PAHs) The %R value for d10-2-methylnapthalene was less than the control limit in Sample SSI-SS-09_0-0.39. The positive results and reporting limits for all analytes in this sample were qualifited as estimated (J/UJ) in this sample.

**SDG AOR4:** (Pentachlorophenol) The %R value for 2,4,6-tribromophenol was greater than the control limit in Sample SSI-SC-DUP-01. The positive result for this analyte in this sample was qualified as estimated (J) in this sample.

**SDG AUJ6:** (SIM-PAHs) The %R values for d10-fluoranthene, d10-2-methylnephthalene, and d14-debenzo(a,h)anthracene were less than the control limits in the matrix spike sample SSI-SC-06_4-6. No action is required for individual QC samples unless the data indicates the presence of a systemic outlier.

### Method and Equipment Rinsate Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For all sample batches, method blanks for all applicable methods were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in any of the method blanks.

**SDG AHU9:** (Dioxins/Furans) There was a positive result, which was greater than 3x the reporting limit, for OCDD in the method blank extracted on 6/18/15 (Lab Sample ID: MB-061815). The associated field samples exhibited positive results for this analyte. However, in each case the sample concentrations were greater than 10x the amount found in the blank. Also, there were positive results for 1,2,3,4,6,7,8-HPCDD, and 1,2,3,4,6,7,8-HPCDF (less than the reporting limit) in this same method blank. The associated field samples exhibited positive results for these analytes. However, in each case the sample concentrations were greater than 5x the amount found in the blank.

According to the guidelines above, no qualifications were required for these trace amounts in the blank.

**SDG AKF6:** (Dioxins/Furans) There was a positive result, which was less than 3x the reporting limit, for OCDD in the method blank extracted on 8/10/15 (Lab Sample ID: MB-081015). The associated field sample exhibited a positive result for this analyte. However, in this case the sample concentration was greater than 10x the amount found in the blank and greater than 3x the reporting limit. Also, there was a positive result for 1,2,3,4,7,8,9-HPCDF which was less than the reporting limit in this same method blank. The associated field sample exhibited a positive result for these analyte; however, the sample concentration was greater than 10x the amount found in the blank and greater than the reporting limit.

According to the guidelines above, no qualifications were required for these trace amounts in the blank.

**SDG AOL1:** (SVOCs) There was a positive result for diethylphthalate in the method blank extracted on 10/21/15 (Lab Sample ID: MB-102115). The associated field samples exhibited positive results which were less than 10x the amount found in the method blank. The positive results for diethylphthalate were qualified (U) as not-detected in the following samples: SSI-SS-05_0-0.39, SSI-SS-06_0-0.39, and SSI-SS-07_0-0.39.

**SDG AOS3, AOS6:** (SVOCs) There was a positive result for diethylphthalate in the method blank extracted on 10/23/15 (Lab Sample ID: MB-102315). The associated field samples exhibited positive results which were less than 10x the amount found in the method blank. The positive results for diethylphthalate were qualified (U) as not-detected in the following samples: SSI-SS-03_0-0.39, SSI-SS-01_0-0.39, SSI-SS-DUP-3, SSI-SS-02_0-0.39, and SSI-SS-04_0-0.39.

Equipment rinsate blanks were collected at the site in order to ensure that the equipment used in the sampling procedures do not cross contaminate other samples with concentrations of the analytes of interest. Equipment Rinsate blanks were collected at a frequency of once per day of field sampling.

There were four equipment rinsate blanks collected for this sampling event: Rinseate-151012, Rinsate-151013, Rinseate-151014, and Rinsate-151015. None of the analytes of interest were detected above the reporting limits in any of blanks, with the exceptions below:

(Dioxins/Furans): The four equipment blanks and the field samples were analyzed at two separate laboratories. The equipment blanks were analyzed at ARI, whereas the entire set of field samples (both surface and subsurface) were analyzed at Frontier Analytical. In the validation process, each equipment blank was first assessed for method blank contamination, in order to determine which potential contaminants were attributable to the laboratory, and which contaminants originated at the site. After this initial assessment was concluded, each only the equipment blank collected on October 14, 2015 (Rinsate-151015 above) was shown to contain trace amounts of Dioxin/Furan contamination generally below the reporting limits of the blank. As the associated field sample concentrations were higher than 10x the amount found in the equipment blank, no further qualifiers were applied.

### Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery (%R) is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The %R control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

For inorganic organic methods, the matrix spike is followed by a post-digestion spike sample if any element percent recoveries were outside the control limits in the matrix spike. The %R control limits for inorganic matrix spikes are 75 percent to 125 percent. The %R control limits for organic MS/MSD sample sets are the internal laboratory limits which are updated once per year.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the %R and RPD values were within the proper control limits, with the following exceptions:

**SDG AOL1:** (SVOCs) The laboratory performed an MS/MSD sample set on Sample SSI-SS-07_0-0.39. The MSD %R values for benzo(a)pyrene, Total benzofluoranthenes, chrysene, fluoranthene, and pyrene were greater than the control limits in this QC sample set. However, the corresponding MS %R values for each of these analytes were within the control limits. Therefore, no qualifiers were applied.

Also, the RPD values for benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, Total benzofluoranthenes, chrysene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene exceeded the control limits in the same sample set. As the precision criteria for these analytes were within the control limits in all other QC paramters, no action was taken.

(SIM-SVOCs) The laboratory performed an MS/MSD sample set on Sample SSI-SS-07_0-0.39. The RPD value for dibenz(a,h)anthracene exceeded the control limit of 30 percent in the sample set. As the precision criteria for this analyte was within the control limits in all other QC paramters, no action was taken.

**SDG AOM9:** (TOC) The laboratory performed a matrix spike on Sample SSI-SC-07_2-4. The TOC MS %R value exceeded the control limit in this QC sample. However, the measurement is not considered meaningful as per the NFG documents because the parent sample concentration was greater than four times the amount spiked into the sample. No further action was taken.

(PAHs) The laboratory performed an MS/MSD sample set on Sample SSI-SC-07_2-4. There was no recovery for eight analytes in this QC sample set. However, it was noted that no less than six parent sample analyte concentrations exceeded their respective calibration ranges in the parent sample. The laboratory did not dilute the MS/MSD sample set. In this case, professional judgement was used in validation to determine that the instrumentation at this point could have been saturated by these target analtyes mentioned and left incapable of producing meaningful measurements of matrix accuracy and precision for other target analtyes. Therefore, no futher action was taken for any outliers in this MS/MSD sample set.

**SDG AOR4:** (TOC) The laboratory performed a matrix spike on Sample SSI-SC-01_2-4. The TOC MS %R value was less than the control limit in this QC sample. The positive result for TOC was qualified as estimated (J) in the parent sample.

(SIM-PAHs) The laboratory performed an MS/MSD sample set on Sample SSI-SC-01_2-4. The %R values for pyrene were both greater than the control limits. Also, the MSD %R values for seven target analytes were greater than the control limits; however, the corresponding MS %R values for each analyte were within their respective control limits. Also, the RPD values for six target analytes exceeded the control limits. As the precision criteria for these analytes were within the control limits in all other QC paramters, no action was taken.

(Chlorophenols) The laboratory performed an MS/MSD sample set on Sample SSI-SC-01_2-4. The MS/MSD %R values for pentachlorophenol were less than the control limits in this sample set. The positive result for pentachlorophenol was qualified as estimated (J) in the parent sample.

**SDG AOS3:** (SVOCs) The laboratory performed an MS/MSD sample set on Sample SSI-SS-01_0-0.39. The RPD value for benzyl alcohol exceeded the control limits in the sample set. There was no positive result for this analtye in the parent sample, therefore no further qualification was required.

**SDG AUJ6:** (SIM-PAHs) The laboratory performed an MS/MSD sample set on Sample SSI-SC-06_4-6. Several %R and RPD values were outside of the control limits because several target analyte concentrations exceeded the amount spiked into the sample, therefore no further qualification was required.

### Laboratory Control Samples/Ongoing Precision and Recovery Samples

A laboratory control sample (LCS) or an Ongoing Precision and Recovery Sample (OPR) is a blank sample that is spiked with a known amount of analyte and then analyzed. These internal QC samples are similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/OPR control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/OPR analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery (%R) control limits for an LCS/OPR analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD or OPR analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the %R and RPD values were within the proper control limits.

**SDG AOS3 & AOS6:** (SVOCs) The %R value for benzyl alcohol was less than the control limits in the blank spike extracted on 10/23/15 (LCS-102315). The positive results for detected samples and the reporting limits for non-detected samples were qualified as estimated (J/UJ) in samples SSI-SS-01_0-0.39, SSI-SS-02_0-0.39, SSI-SS-03_0-0.39, SSI-SS-DUP-3, and SSI-SS-04_0-0.39.

### Field Duplicates

In order to assess precision, field duplicate samples were collected and analyzed along with the reviewed sample batches. The duplicate samples were analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration less than five times the reporting limit for that sample, then the absolute difference is used as a performance metric instead of the RPD. The RPD control limit for sediment samples is 50 percent. The absolute difference control limit is 2 times the reporting limit.

**SDG AOS3:** One of two field duplicate sample pairs, SSI-SS-01_0-0.39/SSI-SS-DUP-03, was submitted with this sample delivery group.

(SVOC): The RPD/absolute difference values exceeded the control limits for phenol, fluoranthene, pyrene, benzo(a)anthracene, indeno(1,2,3-cd)pyrene, and Total benzofluoranthenes. The positive results and reporting limits for any of these analytes that were not-detected were qualified as estimated (J/UJ) in both samples.

**SDG AOR4:** One field duplicate sample pair, SSI-SC-01_0-2/SSI-SC-DUP-01, was submitted with this sample delivery group.

(SIM-PAHs) The RPD/absolute difference values exceeded the control limits for 2-methylnaphthalene and acenaphthylene. The positive results and reporting limits for any of these analytes that were not-detected were qualified as estimated (J/UJ) in both samples.

**SDG AOM9:** One field duplicate sample pair, SSI-SC-07_0-2/SSI-SC-Dup-04, was submitted with this sample delivery group.

**SDG AOS3:** One field duplicate sample pair, SSI-SC-04_0-2/SSI-SC-Dup-03, was submitted with this sample delivery group.

(NWTPH-Dx) The RPD/absolute difference value exceeded the control limit for Diesel range hydrocarbons. The positive result was qualified as estimated (J/UJ) in both samples.

### Initial Calibrations (ICALs)

All initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. For inorganic analyses, all percent recoveries were within the control limits of 90 percent and 110 percent. For organic analyses, all percent relative standard deviation (%RSD) and relative response factors (RRF) values were within the control limits stated in either the EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, 2008) or the EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (EPA 2011).

### Continuing Calibrations (CCALs)

All continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. For inorganic analyses, all percent recoveries were within the control limits of 90 percent and 110 percent. For organic analyses, all percent difference (%D) and relative response factors (RRF) values were within the control limits in either the EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 2008) or the EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (EPA 2011).

### Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in any environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12 hour sample run. For organic analyses, the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. For inorganic analyses, the control limits for internal standard recoveries are 60 percent to 125 percent of the calibration standard. All internal standard recoveries were within the control limits.

### Dilutions

(PAHs and SVOCs) There were several cases where target analytes exceeded the linear calibarion range of the analytical instrument. In these cases, the laboratory flagged these analytes with an “E”, and re-analyzed these samples at various dilutions. In each case, both sets of data were reported by the laboratory. In order to avoid duplicate analytical reporting, the validation labeled all “E” flags with Do-Not-Report (DNR). Correspondingly, the validation labeled all other analytes in the dilutions with Do-Not-Report so that only one concise set of analytes per sample were to be used for this project.

### Miscellaneous

**SDG AHU9 and AKF6** (Dioxin/Furans): The positive results for several compounds were noted by the laboratory to represent the estimated maximum possible concentration (EMPC) for these analytes in Samples CL-SG-1_0-0.33, CL-SG-3_0-0.33 and CL-SG-4_0-0.33. This is typically due to the compounds exhibiting ion abundance ratios that are outside of the allowable control limits set forth in the the EPA method and the National Functional Guidelines. In each case the concentrations were qualified as not detected (U) at the elevated reporting limits.

Also, the laboratory noted that congeners 1,2,3,4,7,8-HxCDF and 2,3,4,6,7,8-HxCDF coeluted with Polybrominated diphenyl ethers (PBDE) in Sample CL-SG-1_0-0.33. In some cases, these congeners were already qualified as not detected above. However, in the case of 1,2,3,4,7,8-HxCDF, there was no additional EMPC qualification. This congener was qualified as estimated (J) in Sample CL-SG-1_0-0.33.

**SDG AOL1** (SVOCs): The benzyl alcohol results were noted by the laboratory to be cases of low spectral mass spectrometer matches in Samples SSI-SS-05_0-0.39 and SSI-SS-06_0-0.39. The positive results for these analytes were qualified as estimated (J) in both samples.

**SDG AOM9** (Pentachlorophenol): The column confirmation RPD value for pentachlorophenol was greater than 40 percent in Sample SSI-SC-05_2-4. The positive result for pentachlorophenol was qualified as (NJ) in this sample.

**SDG AOR4** (Pentachlorophenol): The column confirmation RPD value for pentachlorophenol was greater than 40 percent in Samples SSI-SC-01_2-4, SSI-SC-03_0-2, and SSI-SC-03_2-4. The positive results for pentachlorophenol were qualified as (NJ) in these samples.

**SDG AOS3** (SVOCs): The phenol and benzyl alcohol results were noted by the laboratory to be cases of low spectral mass spectrometer matches in Sample SSI-SS-03_0-0.39. The positive results for these analytes were qualified as estimated (J) in this sample.

Pentachlorophenol: The column confirmation RPD values for pentachlorophenol were greater than 40 percent in Samples SSI-SC-04_0-2 and SSI-SC-DUP-03. The positive results for pentachlorophenol were qualified as (NJ) in these samples.

**SDG AWJ5** (Pentachlorophenol): The column confirmation RPD value for pentachlorophenol was greater than 40 percent in Sample PSB-SC-03-0-1. The positive result for pentachlorophenol was qualified as (NJ) in this sample.

**SDG 9350** (Dioxin/Furans): The positive results for Total TCDF, Total PeCDF, and Total HxCDF were flagged as EMPCs in Sample SSI-SS-14_0-0.39. The positive result for Total PeCDD was flagged as an EMPC in Sample SSI-SS-15_0-0.39. Also, the positive results for Total TCDF and Total PeCDF were flagged as EMPCs in Sample SSI-SS-16_0-0.39. In each case the concentrations were qualified as not detected (U) at the elevated reporting limits.

**SDG 9353** (Dioxin/Furans): The positive result for Total TCDF was flagged as an EMPC in Sample SSI-SC-05_4-6. The positive results for Total TCDF, Total PeCDF, and Total HxCDF were flagged as EMPCs in Sample SSI-SC-06_4-6. The positive results for Total TCDF, Total PeCDF, and Total HxCDF were flagged as EMPCs in Sample SSI-SC-07_4-6. In each case the concentrations were qualified as not detected (U) at the elevated reporting limits.

Also, the laboratory noted that Total TCDD coeluted with PBDE in Sample SSI-SC-07_4-6. In the case, there was no additional EMPC qualification. Therefore, this homologue group result was qualified as estimated (J) in Sample SSI-SC-07_4-6.

**SDG 9648** (Dioxin/Furans): The positive results for Total HxCDF were flagged as an EMPC in Samples PSB-SC-01_1-0-1, PSB-SC-03_1-2, and PSB-SC-04_0-1. In each case the concentrations for HxCDF were qualified as not detected (U) at the elevated reporting limits.

Also, the laboratory noted that Total TCDD coeluted with PBDE in samples PSB-SC-01_0-1, PSB-SC-02_0-1, and PSB-SC-02_1-2. In each case, there were no additional EMPC qualifications. These homologue group results were qualified as estimated (J) in all three samples.

### Reporting Limits

In all sample analyses, the positive results for all target analytes were quantitated using instrument responses that were appropriately within the calibration curve used for that instrument. All data met the established criteria for this QC element with one exception below:

- **SDG AHU9** (Dioxins/Furans): The congener OCDD was reported to exceed the linear calibration range of the instrument in Samples CL-SG-3_0-0.33 and CL-SG-4_0-0.33. The positive results for these congeners were qualified as estimated (J) in these samples.

## OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the labeled compounds and OPR sample %R values. Precision could not be assessed for this sampling event as there were no laboratory/field duplicates analyzed. All data are acceptable for the intended use, with the qualifications listed below.

Selected data were qualified as estimated (J/UJ) because of the following:

- Low spectral matches (mass spectrometer analysis)
- Matrix spike %R and RPD outliers
- Laboratory control sample %R outliers
- Surrogate %R outliers
- Field duplicate RPD outliers

Selected data were qualified as estimated (U) because of the following:

- Method blank contamination
- Estimated maximum possible concentrations (ion abundance ratio outliers)

Selected data were qualified as tentatively identified (NJ) because of the following:

- Primary/secondary column confirmation %RSD outliers

## REFERENCES

GeoEngineers, Inc. 2015. “Final Work Plan Supplemental Sediment Investigation”, prepared for City of Bellingham, August 21, 2015

U.S. Environmental Protection Agency (EPA). 2008. “Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,” EPA-540-R-08-01. September 2008.

U.S. Environmental Protection Agency (EPA). 2009. "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (EPA). 2011. "Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review," EPA-540-R-11-016. September 2011.

U.S. Environmental Protection Agency (EPA). 2014. "National Functional Guidelines for Inorganic Superfund Data Review," EPA-540-R-13-001. August 2014.

# C.2. Data Validation Report – EcoChem, Inc.

# DATA VALIDATION REPORT

# SUPPLEMENTAL SEDIMENT INVESTIGATION
# R.G. HALEY SITE – BELLINGHAM, WA

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December 7, 2015

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# PROJECT NARRATIVE

### *Basis for the Data Validation*

This report summarizes the results of summary and full validation (EPA Stage 2B, EPA Stage 4) performed on sediment and quality control sample data for the R.G. Haley Supplemental Sediment Investigation. A complete list of samples is provided in the Sample Index.

Samples were analyzed by Frontier Analytical Laboratory, El Dorado Hills, California. The analytical method and EcoChem project chemists are noted below:

| ANALYSIS | METHOD | PRIMARY REVIEW | SECONDARY REVIEW |
|---|---|---|---|
| Dioxin/Furan Compounds | 1613B | E. Clayton | C. Ransom |

The data were reviewed using guidance and quality control criteria documented in the analytical methods; *Supplemental Sediment Investigation, R.G. Haley Site, Bellingham Washington, Quality Assurance Project Plan (QAPP)* (GeoEngineers August 21, 2015) and *National Functional Guidelines for Chlorinated Dioxin/Furan Data Review* (USEPA 2011).

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as APPENDIX A. A Qualified Data Summary Table is included in APPENDIX B. Data Validation Worksheets and project associated communications will be kept on file at EcoChem, Inc. A qualified laboratory electronic data deliverable (EDD) is also submitted with this report.

# Sample Index
# R.G. Haley Site - Supplemental Sediment Investigation

| SDG | Sample ID | Laboratory ID | Dioxins |
|---|---|---|---|
| 9351 | SSI-SS-08_0-12 | 9351-001 | ✓ |
| 9351 | SSI-SS-10_0-12 | 9351-002 | ✓ |
| 9351 | SSI-SS-11_0-12 | 9351-003 | ✓ |
| 9351 | SSI-SS-12_0-12 | 9351-004 | ✓ |
| 9353 | SSI-SC-03_0-2 | 9353-014 | ✓ |
| 9353 | SSI-SC-03_2-4 | 9353-015 | ✓ |
| 9353 | SSI-SC-05_0-2 | 9353-010 | ✓ |
| 9353 | SSI-SC-05_2-4 | 9353-011 | ✓ |
| 9353 | SSI-SC-06_0-2 | 9353-001 | ✓ |
| 9353 | SSI-SC-06_2-4 | 9353-002 | ✓ |
| 9353 | SSI-SC-07_0-2 | 9353-005 | ✓ |
| 9353 | SSI-SC-07_2-4 | 9353-007 | ✓ |
| 9353 | SSI-SC-DUP-04 | 9353-006 | ✓ |
| 9354 | SSI-SC-01_0-2 | 9354-001 | ✓ |
| 9354 | SSI-SC-01_2-4 | 9354-002 | ✓ |
| 9354 | SSI-SC-04_0-2 | 9354-006 | ✓ |
| 9354 | SSI-SC-04_2-4 | 9354-007 | ✓ |
| 9354 | SSI-SC-DUP-01 | 9354-004 | ✓ |
| 9354 | SSI-SC-DUP-03 | 9354-005 | ✓ |

# DATA VALIDATION REPORT
# R.G. Haley Site – Supplemental Sediment Investigation
# Dioxin/Furan Compounds by Method 1613B

This report documents the review of analytical data from the analysis of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Frontier Analytical Laboratory., El Dorado Hills, California. Refer to the SAMPLE INDEX for a complete list of samples.

| SDG | NUMBER OF SAMPLES | VALIDATION LEVEL |
|---|---|---|
| 9351 | 4 Sediment | EPA Stage 4 |
| 9353 | 9 Sediment | EPA Stage 2B |
| 9354 | 6 Sediment | EPA Stage 2B |

## DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

*SDG 9351:* All client identifications (ID) on chain-of-custody (COC) were missing the final segment of "_0-12". Samples were logged in according the IDs on the sample containers.

## EDD TO HARDCOPY VERIFICATION

Sample results and related quality control data were received as an electronic data deliverable (EDD) and laboratory report. The EDD was verified against the laboratory report (10%). No errors were noted.

## TECHNICAL DATA VALIDATION

The quality control (QC) requirements reviewed are summarized in the following table:

| | | | |
|---|---|---|---|
| ✓ | Sample Receipt, Preservation, and Holding Times | ✓ | Ongoing Precision and Recovery (OPR) |
| ✓ | System Performance and Resolution Checks | 2 | Field Duplicates |
| ✓ | Initial Calibration (ICAL) | ✓ | Target Analyte List |
| ✓ | Calibration Verification | 2 | Reported Results |
| ✓ | Blanks (Laboratory and Field) | 2 | Compound Identification |
| ✓ | Labeled Compound Recovery | 1 | Calculation Verification |
| 1 | Matrix Spike/Matrix Spike Duplicates (MS/MSD) | | |

✓ ***Stated method quality objectives (MQO) and QC criteria have been met. No outliers are noted or discussed.***
1 ***Quality control results are discussed below, but no data were qualified.***
2 ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

## Matrix Spike/Matrix Spike Duplicates

Samples were inadvertently marked for matrix spike/matrix spike duplicate (MS/MSD) analysis on the COCs, however MS/MSDs are not required by the analytical method or the quality assurance project plan (QAPP). The MS/MSD results were not used to evaluate laboratory precision or accuracy.

## Field Duplicates

The field duplicate relative percent difference (RPD) control limit is 50% for concentrations greater than 5x the reporting limit (RL). For concentrations less than 5x the RL, the difference between the sample result and the duplicate result must be less than 2x the RL. Outlier results were estimated (J-9). Field duplicate samples and any outliers are noted below.

*SDG 9353:* One set of field duplicates was submitted: SSI-SC-07_0-2 and SSI-SC-DUP-04. The difference between the two results for 1,2,3,6,7,8-HxCDF was greater than the control limit.

*SDG 9354:* Two sets of field duplicates were submitted: SSI-SC-01_0-2 & SSI-SC-DUP-01 and SSI-SC-04_0-2 & SSI-SC-DUP-03.

For samples SSI-SC-01_0-2 and SSI-SC-DUP-01, the RPD values for OCDD, 1,2,3,4,6,7,8-HpCDD, Total HpCDD, Total HpCDF, Total HXCDF, OCDF, 1,2,3,4,7,8,9-HpCDF, and 1,2,3,4,6,7,8-HpCDF were greater than the control limit.

For samples SSI-SC-04_0-2 and SSI-SC-DUP-03, the RPD value for Total TCDD was greater than the control limit.

## Reported Results

*SDG 9353:* The laboratory assigned an "E" flag to two OCDD results to indicate the concentrations exceeded the calibration range of the instrument. These results were estimated (J-20).

## Compound Identification

The method requires the confirmation of 2,3,7,8-TCDF using an alternate GC column if the column that is typically used cannot fully separate 2,3,7,8-TCDF from closely eluting non-target TCDF isomers. The laboratory did performed a second column confirmation as necessary. Result reported from the confirmation column were flagged with an “F”.

The laboratory assigned an "M" flag to one or more analytes to indicate that the ion ratio criterion for positive identification was not met. Since the ion abundance ratio is the primary identification criterion for high resolution mass spectroscopy, an outlier indicates that the reported result may be a false positive. These “M” flagged results were qualified as not detected (U-25) at the reported concentration. The laboratory also assigned “M” flags to total homolog groups. In these cases, the result for the group was estimated (J-25).

Diphenyl ether interferences were present in some samples. The laboratory assigned a “D” flag to the results affected by these interferences. These results were estimated (J-23) to indicate a potential high bias. No action was taken for results qualified as not-detected based on ion ratio outliers.

## Calculation Verification

*SDG 9351:* Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

## OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical method. With the exceptions noted above, accuracy was acceptable as demonstrated by the labeled compound and OPR recoveries and precision was acceptable as demonstrated by the OPR and field duplicate RPD values.

Detection limits were elevated based on ion ratio outliers. Results were estimated because they exceeded the calibration range or due to diphenyl ether interference. Results for total homolog groups with "M" flags were also estimated.

All data, as qualified, are acceptable for use.

ECOCHEM
Data Quality

# APPENDIX A

# DATA QUALIFIER DEFINITIONS
# REASON CODES
# AND CRITERIA TABLES

# DATA VALIDATION QUALIFIER CODES
# Based on National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

| | |
|---|---|
| U | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. |
| J | The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. |
| NJ | The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents the approximate concentration. |
| UJ | The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. |
| R | The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. |

The following is an EcoChem qualifier that may also be assigned during the data review process:

| | |
|---|---|
| DNR | Do not report; a more appropriate result is reported from another analysis or dilution. |

# DATA QUALIFIER REASON CODES

| Group | Code | Reason for Qualification |
|---|---|---|
| Sample Handling | 1 | Improper Sample Handling or Sample Preservation (i.e., headspace, cooler temperature, pH, summa canister pressure); Exceeded Holding Times |
| Instrument Performance | 24 | Instrument Performance (i.e., tune, resolution, retention time window, endrin breakdown, lock-mass) |
| | 5A | Initial Calibration (RF, %RSD, $r^2$) |
| | 5B | Calibration Verification (CCV, CCAL; RF, %D, %R)<br>Use bias flags (H,L)[1] where appropriate |
| | 5C | Initial Calibration Verification (ICV %D, %R)<br>Use bias flags (H,L)[1] where appropriate |
| Blank Contamination | 6 | Field Blank Contamination (Equipment Rinsate, Trip Blank, etc.) |
| | 7 | Lab Blank Contamination (i.e., method blank, instrument blank, etc.)<br>Use low bias flag (L)[1] for negative instrument blanks |
| Precision and Accuracy | 8 | Matrix Spike (MS and/or MSD) Recoveries<br>Use bias flags (H,L)[1] where appropriate |
| | 9 | Precision (all replicates: LCS/LCSD, MS/MSD, Lab Replicate, Field Replicate) |
| | 10 | Laboratory Control Sample Recoveries (a.k.a. Blank Spikes)<br>Use bias flags (H,L)[1] where appropriate |
| | 12 | Reference Material<br>Use bias flags (H,L)[1] where appropriate |
| | 13 | Surrogate Spike Recoveries (a.k.a. labeled compounds, recovery standards)<br>Use bias flags (H,L)[1] where appropriate |
| Interferences | 16 | ICP/ICP-MS Serial Dilution Percent Difference |
| | 17 | ICP/ICP-MS Interference Check Standard Recovery<br>Use bias flags (H,L)[1] where appropriate |
| | 19 | Internal Standard Performance (i.e., area, retention time, recovery) |
| | 22 | Elevated Detection Limit due to Interference (i.e., chemical and/or matrix) |
| | 23 | Bias from Matrix Interference (i.e. diphenyl ether, PCB/pesticides) |
| Identification and Quantitation | 2 | Chromatographic pattern in sample does not match pattern of calibration standard |
| | 3 | 2nd column confirmation (RPD or %D) |
| | 4 | Tentatively Identified Compound (TIC) (associated with NJ only) |
| | 20 | Calibration Range or Linear Range Exceeded |
| | 25 | Compound Identification (i.e., ion ratio, retention time, relative abundance, etc.) |
| Miscellaneous | 11 | A more appropriate result is reported (multiple reported analyses i.e., dilutions, re-extractions, etc. Associated with “R” and “DNR” only) |
| | 14 | Other (See DV report for details) |
| | 26 | Method QC information not provided |

**[1] H = high bias indicated**
**L = low bias indicated**

**Dioxin/Furan Analysis by HRMS**
**(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)**

| QC Element | Acceptance Criteria | Source of Criteria | Action for Non-Conformance | Reason Code | Discussion and Comments |
|---|---|---|---|---|---|
| **Sample Handling** | | | | | |
| Cooler/Storage Temperature Preservation | Waters/Solids ≤ 6°C & in the dark<br>Tissues <-10°C & in the dark<br>**Preservation Aqueous:** If $Cl_2$ is present Thiosulfate must be added and if pH > 9 it must be adjusted to 7 - 9 | NFG (1)<br>Method(2) | J(pos)/R(ND) if thiosulfate not added if $Cl_2$ present;<br>J(pos)/UJ(ND) if pH not adjusted<br>J(pos)/UJ(ND) if temp > 20°C | 1 | **EcoChem PJ, see TM-05** |
| Holding Time | **If properly stored, 1 year or:**<br>**Extraction (all matrices):** 30 days from collection<br>**Analysis (all matrices)**: 45 days from extraction | NFG (1)<br>Method(2) | If not properly stored or HT exceedance:<br>J(pos)/UJ(ND) | 1 | **EcoChem PJ, see TM-05**<br>Gross exceedance = > 1 year 2011 NFG<br>**Note:** Under CWA, SDWA, and RCRA the HT for H2O is 7 days. |
| **Instrument Performance** | | | | | |
| Mass Resolution (Tuning) | PFK (Perfluorokerosene)<br>≥10,000 resolving power at m/z 304.9824.<br>Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) .<br>Analyzed prior to ICAL and at the start and end of each 12 hr. shift. | NFG (1)<br>Method (2) | R(pos/ND) all analytes in all samples associated with the tune | 24 | Notify PM |
| Windows Defining Mix | Peaks for first and last eluters must be within established retention time windows for each selector group (chlorination level) | NFG (1)<br>Method (2) | If peaks are not completely within windows (clipped):<br>If natives are ok, J(pos)/UJ(ND) homologs (Totals)<br>If natives are affected, R all results for that selector group | 24 | Notify PM |
| Column Performance Mix | Both mixes must be analyzed before ICAL and CCAL<br>Valley < 25% (valley = (x/y)*100%)<br>where x = ht. of TCDD (or TCDF) &<br>y = baseline to bottom of valley<br>For all isomers eluting near the 2378-TCDD (TCDF) peak (TCDD only for 8290) | NFG (1)<br>Method (2) | J(pos) if valley > 25% | 24 | **EcoChem PJ, see TM-05, Rev. 2**;<br>Note: TCDF is evaluated only if second column confirmation is performed |
| Initial Calibration **Sensitivity** | S/N ratio > 10 for all native and labeled compounds in CS1 std. | NFG (1)<br>Method (2) | If <10, elevate Det. Limit or R(ND) | 5A | |
| Initial Calibration **Selectivity** | Ion Abundance ratios within QC limits<br>(Table 8 of method 8290)<br>(Table 9 of method 1613B) | NFG (1)<br>Method (2) | If 2 or more ion ratios are out for one compound in ICAL, J(pos) | 5A | **EcoChem PJ, see TM-05, Rev. 2** |

**Dioxin/Furan Analysis by HRMS**
**(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)**

| QC Element | Acceptance Criteria | Source of Criteria | Action for Non-Conformance | Reason Code | Discussion and Comments |
|---|---|---|---|---|---|
| **Instrument Performance (continued)** | | | | | |
| Initial Calibration (Minimum 5 stds.) **Stability** | %RSD < 20% for native compounds<br>%RSD <30% for labeled compounds<br>(%RSD < 35% for labeled compounds under 1613b) | NFG (1)<br>Method (2) | J(pos) natives if %RSD > 20% | 5A | |
| | Absolute RT of $^{13}C_{12}$-1234-TCDD<br>>25 min on DB5 & >15 min on DB-225 | NFG (1)<br>Method (2) | Narrate, no action | | **EcoChem PJ, see TM-05, Rev. 2** |
| Continuing Calibration (Prior to each 12 hr. shift) **Sensitivity** | S/N ratio for CS3 standard > 10 | NFG (1)<br>Method (2) | If <10, elevate Det. Limit or R(ND) | 5B | |
| Continuing Calibration (Prior to each 12 hr. shift) **Selectivity** | Ion Abundance ratios within QC limits<br>(Table 8 of method 8290)<br>(Table 9 of method 1613B) | NFG (1)<br>Method (2) | For congener with ion ratio outlier, J(pos) natives in all samples associated with CCAL. No action for labeled congener ion ratio outliers. | 25 | **EcoChem PJ, see TM-05** |
| Continuing Calibration (Prior to each 12 hr. shift) **Stability** | %D+/-20% for native compounds<br>%D +/-30% for labeled compounds<br>**(Must meet limits in Table 6, Method 1613B)**<br><br>If %D in the closing CCAL are within 25%/35%, the mean RF from the two CCAL may be used to calculate samples **(Section 8.3.2.4 of 8290**). | NFG (1)<br>Method (2) | **Labeled compounds:**<br>Narrate, no action.<br>**Native compounds:**<br>1613: J(pos)/UJ(ND)if %D is outside Table 6 limits<br>J(pos)/R(ND) if %D is +/-75% of Table 6 limits<br><br>8290: J(pos)/UJ(ND) if %D = 20% - 75%<br>J(pos)/R(ND) if %D > 75% | 5B (H,L)3 | |
| | Absolute RT of $^{13}C_{12}$-1234-TCDD and $^{13}C_{12}$-123789-HxCDD should be ± 15 seconds of ICAL<br>RRT for all other compounds must meet criteria listed in Table 2 Method 1316. | NFG (1)<br>Method (2) | Narrate, no action | 5B | **EcoChem PJ, see TM-05** |
| **Blank Contamination** | | | | | |
| Method Blank (MB) | MB: One per matrix per batch of (of ≤ 20 samples)<br>No detected compounds > RL | NFG (1)<br>Method (2) | U(pos) if result is < 5X action level. | 7 | **Hierarchy of blank review:**<br>**#1 - Review MB, qualify as needed**<br>**#2 - Review FB , qualify as needed** |
| Field Blank (FB) | FB: frequency as per QAPP<br>No detected compounds > RL | | U(pos) if result is < 5X action level. | 6 | |

**Dioxin/Furan Analysis by HRMS**
**(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)**

| QC Element | Acceptance Criteria | Source of Criteria | Action for Non-Conformance | Reason Code | Discussion and Comments |
|---|---|---|---|---|---|
| **Precision and Accuracy** | | | | | |
| MS/MSD<br>(recovery) | **MS/MSD not typically required for HRMS analyses.**<br>If lab analyzes MS/MSD then one set per matrix per batch (of ≤ 20 samples)<br>Use most current laboratory control limits | EcoChem standard policy | J(pos) if both %R > UCL - high bias<br>J(pos)/UJ(ND) if both %R < LCL - low bias<br>J(pos)/R(ND) if both %R < 10% - very low bias<br>J(pos)/UJ(ND) if one > UCL & one < LCL, with no bias<br>**PJ if only one %R outlier** | 8 (H,L)[3] | No action if only one spike %R is outside criteria.<br>No action if parent concentration is >4x the amount spiked.<br><br>Qualify parent sample only unless other QC indicates systematic problems. |
| MS/MSD<br>(RPD) | **MS/MSD not typically required for HRMS analyses.**<br>If lab analyzes MS/MSD then one set per matrix per batch (of ≤ 20 samples)<br>Use most current laboratory control limits | EcoChem standard policy | J(pos) in parent sample if RPD > CL | 9 | Qualify parent sample only. |
| LCS<br>(or OPR) | One per lab batch (of ≤ 20 samples)<br>Use most current laboratory control limits<br>**or**<br>Limits from Table 6 of 1613B | NFG (1)<br>Method (2) | J(pos) if %R > UCL - high bias<br>J(pos)/UJ(ND) if %R < LCL - low bias<br>J(pos)/R(ND) if %R < 10% - very low bias | 10 (H,L)[3] | No action if only one spike %R is outside criteria, when LCSD is analyzed.<br><br>Qualify all associated samples. |
| LCS/LCSD<br>(RPD) | **LCSD not typically required for HRMS analyses.**<br>One set per matrix and batch of 20 samples<br>RPD < 35% | Method (2)<br>Ecochem standard policy | J(pos) assoc. compound in all samples if RPD > CL | 9 | Qualify all associated samples. |
| Lab Duplicate<br>(RPD) | **Lab Dup not typically required for HRMS analyses.**<br>One per lab batch (of ≤ 20 samples)<br>Use most current laboratory control limits | EcoChem standard policy | J(pos)/UJ(ND) if RPD > CL | 9 | |
| Labeled Compounds<br>(Internal Standards) | Added to all samples<br>%R = 40% - 135% in all samples 8290<br>%R must meet limits in Table 7 Method 1613B | NFG (1)<br>Method (2) | J(pos) if %R > UCL - high bias<br>J(pos)/UJ(ND) if %R < LCL - low bias<br>J(pos)/R(ND) if %R < 10% - very low bias | 13 (H,L)[3] | |
| Field Duplicates | Solids: RPD <50%<br>OR difference < 2X RL (for results < 5X RL)<br><br>Aqueous: RPD <35%<br>OR difference < 1X RL (for results < 5X RL) | EcoChem standard policy | Narrate and qualify if required by project | 9 | **Use professional judgment** |

**Dioxin/Furan Analysis by HRMS**
**(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)**

| QC Element | Acceptance Criteria | Source of Criteria | Action for Non-Conformance | Reason Code | Discussion and Comments |
|---|---|---|---|---|---|
| **Compound ID and Calculation** | | | | | |
| Quantitation/ Identification | All ions for each isomer must maximize within ± 2 seconds.<br>S/N ratio >2.5<br>Ion ratios must meet criteria listed in Table 8 Method 8290,<br>or Table 9 of 1613B; RRTs w/in limits in Table 2 of 1613B | NFG (1)<br>Method (2) | Narrate in report; qualify if necessary<br>NJ(pos) for retention time outliers.<br>U(pos) for ion ratio outliers. | 25 | **EcoChem PJ, see TM-05** |
| EMPC (estimated maximum possible concentration) | If quantitation identification criteria are not met, laboratory should report an EMPC value. | NFG (1)<br>Method (2) | If laboratory correctly reported an EMPC value, qualify the native compound U(pos) to indicate that the value is a detection limit and qualify total homolog groups J (pos) | 25 | **Use professional judgment See TM-18** |
| Interferences | Interferences from chlorodiphenyl ether compounds | NFG (1)<br>Method (2) | J(pos)/UJ(ND) if present | 23 | **See TM-16** |
| | Lock masses must not deviate ± 20% from values in Table 8 of 1613B | Method (2) | J(pos)/UJ(ND) if present | 24 | **See TM-17** |
| Second Column Confirmation | All 2,3,7,8-TCDF hits must be confirmed on a DB-225 (or equiv) column. All QC criteria must also be met for the confirmation analysis. | NFG (1)<br>Method (2) | Report the DB-225 value.<br>If not performed use PJ. | 3 | DNR-11 DB5 result if both results from both columns are reported.<br>**EcoChem PJ, see TM-05** |
| Calculation Check | Check 10% of field & QC sample results | EcoChem standard policy | Contact laboratory for resolution and/or corrective action | na | Full data validation only. |
| **Electronic Data Deliverable (EDD)** | | | | | |
| Verification of EDD to hardcopy data | EcoChem verify @ 10% unless problems noted; then increase level up to 100% for next several packages. | | Depending on scope of problem, correct at EcoChem (minor issues) to resubmittal by laboratory (major issues). | na | EcoChem Project Manager and/or Database Administrator will work with lab to provide long-term corrective action. |
| Dilutions, Re-extractions and/or Reanalyses | Report only one result per analyte | Standard reporting policy | Use "DNR" to flag results that will not be reported. | 11 | |

(pos) - positive (detected) results; (ND) - not detected results

[1] National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) & Chlorinated Dibenzofurans (CDFs) Data Review, September 2011
[2] Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), USEPA SW-846, Method 8290
[2] EPA Method 1613, Rev.B, Tetra-through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGS/HRMS, October 1994
[3] NFG 2013 suggests using "+ / -" to indicate bias; EcoChem has chosen "H" = high bias indicated; "L" = low bias indicated.

ECOCHEM
Data Quality

# APPENDIX B

# QUALIFIED DATA SUMMARY TABLE

# Qualified Data Summary Table
## R.G. Haley Site - Supplemental Sediment Investigation

| SDG | Sample ID | Lab ID | Method | Analyte | Result | Units | Lab Flag | DV Qualifier | DV Reason |
|---|---|---|---|---|---|---|---|---|---|
| 9351 | SSI-SS-08_0-12 | 9351-001 | EPA1613B | Total HxCDF | 129 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-08_0-12 | 9351-001 | EPA1613B | Total PeCDF | 30.3 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-08_0-12 | 9351-001 | EPA1613B | Total TCDF | 22.1 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-10_0-12 | 9351-002 | EPA1613B | Total HxCDF | 116 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-10_0-12 | 9351-002 | EPA1613B | Total PeCDF | 34.4 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-10_0-12 | 9351-002 | EPA1613B | Total TCDF | 48.9 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-11_0-12 | 9351-003 | EPA1613B | 1,2,3,6,7,8-HxCDF | 2.89 | pg/g | D,J,M | U | 25 |
| 9351 | SSI-SS-11_0-12 | 9351-003 | EPA1613B | Total HxCDF | 107 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-11_0-12 | 9351-003 | EPA1613B | Total PeCDF | 39.9 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-11_0-12 | 9351-003 | EPA1613B | Total TCDF | 77.4 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-12_0-12 | 9351-004 | EPA1613B | Total HxCDF | 79.6 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-12_0-12 | 9351-004 | EPA1613B | Total PeCDF | 30.2 | pg/g | D,M | J | 23,25 |
| 9351 | SSI-SS-12_0-12 | 9351-004 | EPA1613B | Total TCDF | 56.9 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_0-2 | 9353-014 | EPA1613B | Total HxCDF | 260.0 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_0-2 | 9353-014 | EPA1613B | Total PeCDF | 94.1 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_0-2 | 9353-014 | EPA1613B | Total TCDF | 86.9 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_2-4 | 9353-015 | EPA1613B | Total HxCDF | 150.0 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_2-4 | 9353-015 | EPA1613B | Total PeCDF | 46.2 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-03_2-4 | 9353-015 | EPA1613B | Total TCDF | 33.3 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_0-2 | 9353-010 | EPA1613B | Total HxCDF | 1710 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_0-2 | 9353-010 | EPA1613B | Total PeCDF | 358 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_0-2 | 9353-010 | EPA1613B | Total TCDF | 183 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_2-4 | 9353-011 | EPA1613B | Total HxCDF | 475 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_2-4 | 9353-011 | EPA1613B | Total PeCDF | 132 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-05_2-4 | 9353-011 | EPA1613B | Total TCDF | 159 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_0-2 | 9353-001 | EPA1613B | 1,2,3,6,7,8-HxCDF | 74.9 | pg/g | D,M | U | 25 |
| 9353 | SSI-SC-06_0-2 | 9353-001 | EPA1613B | OCDD | 80600 | pg/g | E | J | 20 |
| 9353 | SSI-SC-06_0-2 | 9353-001 | EPA1613B | Total HxCDF | 5090 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_0-2 | 9353-001 | EPA1613B | Total PeCDF | 1090 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_0-2 | 9353-001 | EPA1613B | Total TCDF | 310.0 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_2-4 | 9353-002 | EPA1613B | OCDD | 163000 | pg/g | E | J | 20 |

# Qualified Data Summary Table

## R.G. Haley Site - Supplemental Sediment Investigation

| SDG | Sample ID | Lab ID | Method | Analyte | Result | Units | Lab Flag | DV Qualifier | DV Reason |
|---|---|---|---|---|---|---|---|---|---|
| 9353 | SSI-SC-06_2-4 | 9353-002 | EPA1613B | Total HxCDF | 6720 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_2-4 | 9353-002 | EPA1613B | Total PeCDF | 911 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-06_2-4 | 9353-002 | EPA1613B | Total TCDF | 442 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_0-2 | 9353-005 | EPA1613B | 1,2,3,6,7,8-HxCDF | 5.36 | pg/g | | J | 9 |
| 9353 | SSI-SC-07_0-2 | 9353-005 | EPA1613B | Total HxCDF | 246 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_0-2 | 9353-005 | EPA1613B | Total PeCDF | 72.6 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_0-2 | 9353-005 | EPA1613B | Total TCDF | 35.6 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_2-4 | 9353-007 | EPA1613B | Total HxCDF | 439 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_2-4 | 9353-007 | EPA1613B | Total PeCDF | 144 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-07_2-4 | 9353-007 | EPA1613B | Total TCDD | 25.7 | pg/g | M | J | 25 |
| 9353 | SSI-SC-07_2-4 | 9353-007 | EPA1613B | Total TCDF | 50.1 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-DUP-04 | 9353-006 | EPA1613B | 1,2,3,6,7,8-HxCDF | 10.8 | pg/g | | J | 9 |
| 9353 | SSI-SC-DUP-04 | 9353-006 | EPA1613B | Total HxCDF | 294 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-DUP-04 | 9353-006 | EPA1613B | Total PeCDF | 83.6 | pg/g | D,M | J | 23,25 |
| 9353 | SSI-SC-DUP-04 | 9353-006 | EPA1613B | Total TCDF | 38.6 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | 1,2,3,4,6,7,8-HpCDD | 6000 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | 1,2,3,4,6,7,8-HpCDF | 578 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | 1,2,3,4,7,8,9-HpCDF | 29.2 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | OCDD | 68000 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | OCDF | 3050 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | Total HpCDD | 12000 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | Total HpCDF | 2910 | pg/g | | J | 9 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | Total HxCDF | 716 | pg/g | D,M | J | 9,23,25 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | Total PeCDF | 133 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-01_0-2 | 9354-001 | EPA1613B | Total TCDF | 71.5 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-01_2-4 | 9354-002 | EPA1613B | Total HxCDF | 419 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-01_2-4 | 9354-002 | EPA1613B | Total TCDF | 70.8 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-04_0-2 | 9354-006 | EPA1613B | Total TCDD | 22.7 | pg/g | | J | 9 |
| 9354 | SSI-SC-04_0-2 | 9354-006 | EPA1613B | Total TCDF | 24.6 | pg/g | M | J | 25 |
| 9354 | SSI-SC-04_2-4 | 9354-007 | EPA1613B | Total HxCDF | 366 | pg/g | D,M | J | 9,23,25 |
| 9354 | SSI-SC-04_2-4 | 9354-007 | EPA1613B | Total PeCDF | 75.1 | pg/g | D,M | J | 23,25 |

# Qualified Data Summary Table
# R.G. Haley Site - Supplemental Sediment Investigation

| SDG | Sample ID | Lab ID | Method | Analyte | Result | Units | Lab Flag | DV Qualifier | DV Reason |
|---|---|---|---|---|---|---|---|---|---|
| 9354 | SSI-SC-04_2-4 | 9354-007 | EPA1613B | Total TCDF | 60.4 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | 1,2,3,4,6,7,8-HpCDD | 2190 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | 1,2,3,4,6,7,8-HpCDF | 234 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | 1,2,3,4,7,8,9-HpCDF | 13.8 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | OCDD | 22300 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | OCDF | 629 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | Total HpCDD | 4550 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | Total HpCDF | 821 | pg/g | | J | 9 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | Total HxCDF | 421 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | Total PeCDF | 126 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-DUP-01 | 9354-004 | EPA1613B | Total TCDF | 67.2 | pg/g | D,M | J | 23,25 |
| 9354 | SSI-SC-DUP-03 | 9354-005 | EPA1613B | Total TCDD | 41.0 | pg/g | | J | 9 |

# APPENDIX D
## Updated RI Data Summary Statistics

# Table D-1

Updated Remedial Investigation Summary Statistics
R.G. Haley Site
Bellingham, Washington

| Sediment Depth Zone | Analyte | Total Samples per Depth Zone | Frequency of Detection (%) | Minimum Detection Limit | Maximum Detection Limit | Minimum Dectected Concentration | Mean Dectected Concentration | Median Detected Concentration | Maximum Detected Concentration | Maximum Concentration - TOC-Normalized | Frequency of Exceedance - Detects Only (%) | Magnitude of Exceedance of Dry-weight Screening Levels | Magnitude of Exceedance of TOC-normalized Screening Levels | Dry-weight Sediment Screening Level | TOC-Normalized Screening Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface | Diesel-range hydrocarbons | 13 | 46.2 | 6.1 | 21 | 12 | 57.0 | 18.0 | 220 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| Surface | Heavy Oil-Range Hydrocarbons | 13 | 92.3 | 12 | 12 | 42 | 131.8 | 87.5 | 430 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| Surface | Total Petroleum Hydrocarbons | 13 | 92.3 | 12 | 12 | 54 | 160.8 | 89.5 | 650 | NA | 15.4 | 2.5 | NA | 260 mg/kg | NA |
| Surface | Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | 32 | 100 | NA | NA | 9.49 | 52.2 | 31.1 | 200.8 | NA | 100 | 13.4 | NA | 15 ng/kg | NA |
| Surface | 1-Methylnaphthalene | 5 | 60 | 20 | 20 | 15 | 22.0 | 25.0 | 26 | NA | No screening level | No screening level | No screening level | No screening level | No screening level |
| Surface | Total cPAH TEQ (ND=0.5RL) | 36 | 100 | NA | NA | 8.28 | 386.5 | 173.0 | 3494 | NA | 83.3 | 166 | NA | 21 µg/kg | NA |
| Surface | 1,2,4-Trichlorobenzene | 28 | 0 | 2 | 88 | NA | NA | 28.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Surface | 1,3-Dichlorobenzene (m-Dichlorobenzene) | 28 | 0 | 2 | 88 | NA | NA | 29.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Surface | Hexachloroethane | 10 | 0 | 19 | 88 | NA | NA | 38.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Surface | Hexachlorobutadiene | 27 | 0 | 3.6 | 88 | NA | NA | 26.1 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Surface | N-Nitrosodiphenylamine (as diphenylamine) | 28 | 0 | 3.6 | 88 | NA | NA | 29.1 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Surface | Benzoic Acid | 28 | 14.3 | 190 | 1800 | 110 | 337.5 | 370.0 | 500 | NA | 0 | <1 | NA | 650 µg/kg | NA |
| Surface | Benzyl Alcohol | 28 | 10.7 | 19 | 130 | 37 | 55.0 | 50.0 | 78 | NA | 3.6 | 1.4 | NA | 57 µg/kg | NA |
| Surface | 2,4-Dimethylphenol | 28 | 17.9 | 4.2 | 440 | 19 | 41.8 | 42.0 | 82 | NA | 10.7 | 2.8 | NA | 29 µg/kg | NA |
| Surface | 2-methylphenol (o-Cresol) | 27 | 14.8 | 4.2 | 88 | 24 | 35.5 | 35.5 | 47 | NA | 0 | <1 | NA | 63 µg/kg | NA |
| Surface | 4-methylphenol (p-Cresol) | 28 | 35.7 | 19 | 88 | 24 | 207.1 | 176.0 | 450 | NA | 0 | <1 | NA | 670 µg/kg | NA |
| Surface | Pentachlorophenol | 33 | 69.7 | 93 | 510 | 12 | 240.6 | 180.0 | 580 | NA | 42.4 | 5.8 | NA | 100 µg/kg | NA |
| Surface | Phenol | 28 | 32.1 | 15 | 270 | 30 | 168.0 | 170.0 | 410 | NA | 0 | <1 | NA | 420 µg/kg | NA |
| Surface | Mercury | 14 | 100 | NA | NA | 0.05 | 0.3 | 0.3 | 0.45 | NA | 7.1 | 1.1 | NA | 0.41 mg/kg | NA |
| Sub-surface | Diesel-range hydrocarbons | 82 | 67.1 | 6.4 | 37 | 8.3 | 1224.4 | 130.0 | 37000 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| Sub-surface | Heavy Oil-Range Hydrocarbons | 82 | 80.5 | 13 | 44 | 22 | 1199.5 | 190.0 | 27000 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| Sub-surface | Total Petroleum Hydrocarbons | 82 | 84.1 | 13 | 44 | 8.3 | 2099.3 | 260.0 | 50000 | NA | 42.7 | 192 | NA | 260 mg/kg | NA |
| Sub-surface | Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | 57 | 100 | NA | NA | 0.468 | 130.2 | 50.1 | 608 | NA | 86 | 40 | NA | 15 ng/kg | NA |
| Sub-surface | 1-Methylnaphthalene | 35 | 68.6 | 19 | 150 | 9.5 | 260.3 | 46.5 | 4700 | NA | No screening level | No screening level | No screening level | No screening level | No screening level |
| Sub-surface | Total cPAH TEQ (ND=0.5RL) | 97 | 81.4 | 1.058 | 1613 | 4.45 | 680.9 | 290.0 | 12080 | NA | 74.2 | 575 | NA | 21 µg/kg | NA |
| Sub-surface | 1,2,4-Trichlorobenzene | 75 | 0 | 0.93 | 490 | NA | NA | 27.1 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | 1,2-Dichlorobenzene (o-Dichlorobenzene) | 75 | 0 | 0.93 | 490 | NA | NA | 26.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | 1,3-Dichlorobenzene (m-Dichlorobenzene) | 75 | 0 | 0.93 | 490 | NA | NA | 26.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | Hexachlorobenzene | 81 | 0 | 1.5 | 490 | NA | NA | 25.5 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | Hexachloroethane | 38 | 0 | 7.6 | 490 | NA | NA | 50.4 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | Hexachlorobutadiene | 73 | 0 | 1.5 | 490 | NA | NA | 27.4 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | Benzoic Acid | 74 | 2.7 | 31 | 9700 | 82 | 166.0 | 166.0 | 250 | NA | 0 | <1 | NA | 650 µg/kg | NA |
| Sub-surface | Benzyl Alcohol | 74 | 2.7 | 1.5 | 490 | 6.9 | 12.4 | 12.5 | 18 | NA | 0 | <1 | NA | 57 µg/kg | NA |
| Sub-surface | 2,4,5-Trichlorophenol | 5 | 0 | 330 | 1390 | NA | NA | 703.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | 2,4,6-Trichlorophenol | 5 | 0 | 330 | 1390 | NA | NA | 703.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| Sub-surface | 2,4-Dimethylphenol | 75 | 24 | 1.5 | 2500 | 4.1 | 22.9 | 16.0 | 110 | NA | 5.3 | 3.8 | NA | 29 µg/kg | NA |
| Sub-surface | 2-methylphenol (o-Cresol) | 75 | 21.3 | 1.5 | 2500 | 4.6 | 18.2 | 8.8 | 59 | NA | 0 | <1 | NA | 63 µg/kg | NA |
| Sub-surface | 4-methylphenol (p-Cresol) | 75 | 53.3 | 1.9 | 490 | 1.9 | 101.0 | 66.0 | 440 | NA | 0 | <1 | NA | 670 µg/kg | NA |
| Sub-surface | Pentachlorophenol | 95 | 63.2 | 1.5 | 1160 | 5.6 | 600.5 | 240.0 | 4700 | NA | 45.3 | 47 | NA | 100 µg/kg | NA |
| Sub-surface | Phenol | 75 | 41.3 | 2.1 | 490 | 3.1 | 80.9 | 22.0 | 470 | NA | 2.7 | 1.1 | NA | 420 µg/kg | NA |
| Sub-surface | Mercury | 39 | 94.9 | 0.09 | 0.2 | 0.05 | 0.9 | 0.4 | 11.3 | NA | 46.2 | 28 | NA | 0.41 mg/kg | NA |
| All Depth Intervals, Combined | Diesel-range hydrocarbons | 95 | 64.2 | 6.1 | 37 | 8.3 | 1109.6 | 110.0 | 37000 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| All Depth Intervals, Combined | Heavy Oil-Range Hydrocarbons | 95 | 82.1 | 12 | 44 | 22 | 1035.3 | 160.0 | 27000 | NA | Evaluated as part of TPH | Evaluated as part of TPH | NA | Evaluated as part of TPH | NA |
| All Depth Intervals, Combined | Total Petroleum Hydrocarbons | 95 | 85.3 | 12 | 44 | 8.3 | 1812.1 | 220.0 | 50000 | NA | 38.9 | 192 | NA | 260 mg/kg | NA |
| All Depth Intervals, Combined | Total Dioxin/Furan TEQ (ND=0.5DL) - Human/Mammal | 89 | 100 | NA | NA | 0.468 | 102.2 | 44.2 | 608 | NA | 91 | 40 | NA | 15 ng/kg | NA |
| All Depth Intervals, Combined | 1-Methylnaphthalene | 40 | 67.5 | 19 | 150 | 9.5 | 233.8 | 34.0 | 4700 | NA | No screening level | No screening level | No screening level | No screening level | No screening level |
| All Depth Intervals, Combined | Total cPAH TEQ (ND=0.5RL) | 133 | 86.5 | 1.058 | 1613 | 4.45 | 588.7 | 226.5 | 12080 | NA | 76.7 | 575 | NA | 21 µg/kg | NA |
| All Depth Intervals, Combined | 1,2,4-Trichlorobenzene | 103 | 0 | 0.93 | 490 | NA | NA | 27.6 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| All Depth Intervals, Combined | 1,3-Dichlorobenzene (m-Dichlorobenzene) | 103 | 0 | 0.93 | 490 | NA | NA | 27.6 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| All Depth Intervals, Combined | Hexachloroethane | 48 | 0 | 7.6 | 490 | NA | NA | 47.9 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| All Depth Intervals, Combined | Hexachlorobutadiene | 100 | 0 | 1.5 | 490 | NA | NA | 27.0 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| All Depth Intervals, Combined | Benzoic Acid | 102 | 5.9 | 31 | 9700 | 82 | 280.3 | 300.0 | 500 | NA | 0 | <1 | NA | 650 µg/kg | NA |
| All Depth Intervals, Combined | Benzyl Alcohol | 102 | 4.9 | 1.5 | 490 | 6.9 | 38.0 | 37.0 | 78 | NA | 1 | 1.4 | NA | 57 µg/kg | NA |
| All Depth Intervals, Combined | 2,4,5-Trichlorophenol | 5 | 0 | 330 | 1390 | NA | NA | 703.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |

| Sediment Depth Zone | Analyte | Total Samples per Depth Zone | Frequency of Detection (%) | Minimum Detection Limit | Maximum Detection Limit | Minimum Dectected Concentration | Mean Dectected Concentration | Median Detected Concentration | Maximum Detected Concentration | Maximum Concentration - TOC-Normalized | Frequency of Exceedance - Detects Only (%) | Magnitude of Exceedance of Dry-weight Screening Levels | Magnitude of Exceedance of TOC-normalized Screening Levels | Dry-weight Sediment Screening Level | TOC-Normalized Screening Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All Depth Intervals, Combined | 2,4,6-Trichlorophenol | 5 | 0 | 330 | 1390 | NA | NA | 703.8 | Not detected | Not detected | Not detected | Not detected | Not detected | Not a COC | Not a COC |
| All Depth Intervals, Combined | 2,4-Dimethylphenol | 103 | 22.3 | 1.5 | 2500 | 4.1 | 27.0 | 19.0 | 110 | NA | 6.8 | 3.8 | NA | 29 μg/kg | NA |
| All Depth Intervals, Combined | 2-methylphenol (o-Cresol) | 102 | 19.6 | 1.5 | 2500 | 4.6 | 21.7 | 18.5 | 59 | NA | 0 | <1 | NA | 63 μg/kg | NA |
| All Depth Intervals, Combined | 4-methylphenol (p-Cresol) | 103 | 48.5 | 1.9 | 490 | 1.9 | 122.2 | 73.5 | 450 | NA | 0 | <1 | NA | 670 μg/kg | NA |
| All Depth Intervals, Combined | Pentachlorophenol | 128 | 64.8 | 1.5 | 1160 | 5.6 | 500.8 | 230.0 | 4700 | NA | 44.5 | 47 | NA | 100 μg/kg | NA |
| All Depth Intervals, Combined | Phenol | 103 | 38.8 | 2.1 | 490 | 3.1 | 100.5 | 31.5 | 470 | NA | 1.9 | 1.1 | NA | 420 μg/kg | NA |
| All Depth Intervals, Combined | Mercury | 53 | 96.2 | 0.09 | 0.2 | 0.05 | 0.7 | 0.3 | 11.3 | NA | 35.8 | 28 | NA | 0.41 mg/kg | NA |

Notes:

COC = contaminant of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
DL = detection limit
HPAH = high molecular weight polycyclic aromatic hydrocarbons
LPAH = low molecular weight polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilogram
NA = not applicable
ND = not detected
ng/kg = nanograms per kilogram
OC = organic carbon
RL = reporting limit
TEQ = toxicity equivalent
TOC = total organic carbon
TPH - total petroleum hydrocarbons
μg/kg = micrograms per kilogram

# APPENDIX E
## Toxicity Testing Report

RAMBOLL ENVIRON

ENVIRONMENT
& HEALTH

# BIOLOGICAL TESTING RESULTS

# R. G. HALEY SEDIMENT CHARACTERIZATION

# BELLINGHAM, WA

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**Submittal Date:** February 3, 2015

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFDW: | Ash-free dry weight |
| ARI: | Analytical Resources, Inc., Tukwila, WA |
| cm: | Centimeter |
| CSL: | Cleanup Screening Level |
| °C: | Degrees Celsius |
| $EC_{50}$: | Effective Concentration that results in a 50% reduction in a sub-lethal endpoint |
| g: | Grams |
| $LC_{50}$: | Lethal Concentration that results in a 50% reduction in survival |
| L: | Liter |
| µm: | Micrometer |
| mg: | Milligram |
| mg/L: | Milligrams per liter |
| mL: | Milliliter |
| mm: | Millimeter |
| NELAP: | National Environmental Laboratory Accreditation Program |
| NOEC: | No Observed Effect Concentration |
| ppt: | parts per thousand |
| PSEP: | Puget Sound Estuary Protocols (PSEP 1995) |
| SCO: | Sediment Cleanup Objective |
| SMS: | Sediment Management Standards |
| SOP: | Standard operation procedure |
| SSAPA: | Sediment Sampling and Analysis Plan Appendix (SSAPA; WDOE 2008) |
| SMARM: | Sediment Management Annual Review Meeting |
| UIA: | Un-ionized ammonia |
| USACE: | United States Army Corps of Engineers |
| USEPA: | United States Environmental Protection Agency |
| WA: | Washington State |
| WAC: | Washington Administrative Code |
| WDOE: | Washington (State) Department of Ecology |

All testing reported herein was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Ramboll Environ is not responsible for use of less than the complete report. The test results summarized in this report apply only to the sample(s) evaluated.

Brian Hester

Brian Hester

Laboratory Director

Authors: Jay Word – Program Coordinator
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Brian Hester - Laboratory Director

# 1 INTRODUCTION

Ramboll Environ conducted biological toxicity testing with sediment samples collected by GeoEngineers, Inc. as part of a pre-design investigation being performed at the R. G. Haley Site in Bellingham, Washington. Sediments were evaluated for biological effects following guidance provided by the Washington State Department of Ecology (WDOE) Sediment Management Standards (SMS) under the Washington Administrative Code (WAC) 173-204-315. This report presents the results of the toxicity testing portion of the R. G. Haley sediment investigation.

# 2 METHODS

This section summarizes the test methods followed for this biological characterization. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the Sediment Cleanup User's Manual II (SCUM II; WDOE 2015), and the various updates presented during the Sediment Management Annual Review Meeting (SMARM). Sediment toxicity was evaluated using three standard PSEP bioassays; the 10-day amphipod test, the 20-day juvenile polychaete survival and growth test, and the 48-hour benthic larval development test.

## 2.1 Sample Collection Sample and Animal Receipt

Test sediments were collected on October 12, 2015 and three were received at Ramboll Environ on November 30 and December 4, 2015. Reference sediment from Carr Inlet, WA was collected by Ramboll Environ on December 4, 2015 and received on the same day. Sediment samples were stored in a walk-in cold room at 4 ± 2ºC in the dark. The test sediment was not sieved prior to testing. All tests were conducted within the eight week holding time.

Amphipods (*Eohaustorius estuarius*) were supplied by Northwestern Aquatic Sciences in Newport, Oregon. Animals were held in native sediment at 15°C prior to test initiation. Juvenile polychaete worms (*Neanthes arenaceodentata*) were obtained from Aquatic Toxicology Support in Bremerton, Washington. Juvenile polychaetes were held in seawater at 20°C (Neanthes were cultured in water-only and were not held in sediment prior to testing). *Mytilus galloprovincialis* (mussel) broodstock were provided by Taylor Shellfish in Shelton, WA. Broodstock were held in unfiltered seawater at 16°C prior to spawning.

Native *Eohaustorius* sediment from Yaquina Bay, Oregon was also provided by Northwest Aquatic Sciences for use as control sediment treatments for the amphipod and juvenile polychaete tests.

## 2.2 Sample Grain Size and Reference Comparison

Sediment grain size is one of the characteristics used in selecting the appropriate reference sediment(s) to compare the chemical and biological responses of project sediments. The percent fines value is defined as the amount of sediment that passes through a 62.5-µm sieve, expressed as a percentage of the total sample analyzed. This is also the sum of the silt and clay fraction of sediment. Wet-sieve grain size results for the reference sample was conducted in the field (at the time of collection) by Ramboll Environ. The percent-fines determination of the project sediments are summarized in Table 2-1.

**Table 2-1. Sample and Reference Grain Size Comparison.**

| Treatment | Percent Fines[1] | Treatment Compared To: |
|---|---|---|
| CR22 (Reference) | 24% | |
| SS1-SS-03_0-12 | 26% | CR22 |
| SS1-SS-05_0-12 | 19% | CR22 |
| SS1-SS-06_0-12 | 28% | CR22 |

[1] Wet sieve results

All project samples were compared to the reference CR22.

## 2.3 Ultra-Violet Light Exposure

Test sediment samples were exposed to ultra-violet (UV) light during the entire test exposure. The UV light regime followed guidance provided by Appendix C of SCUM II (WDOE 2015). UV light was provided by fluorescent light ballast containing one Duro-Test Vita-Lite® (40W, 5500°K, 91 CRI) fluorescent bulb and one standard fluorescent bulb (Phillips F40CW). The UV bulbs were placed within 12″ above the sediment surface. All test chambers in the UV exposures were left uncovered to prevent any UV loss. Tests were conducted on water-tables to ensure that the additional lighting did not alter water temperatures in the test chambers. In all other respects, the methods followed the standard testing protocols are summarized below.

## 2.4 10-day Amphipod Bioassay

The 10-day acute toxicity test with *E. estuarius* was initiated on December 7, 2015. To prepare the test exposures, approximately 175 mL of sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. The control and reference sediment were tested concurrently with the test treatment. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure porewater and overlying ammonia and sulfides. The remaining surrogate chamber was used for measuring daily water quality throughout the test, as well as porewater and overlying ammonia and sulfides at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as $S^{2-}$ were monitored using a HACH DR/2800 Spectrophotometer.

Test chambers were placed in randomly assigned positions in a 15°C water bath and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Immediately prior to test initiation, water quality parameters were measured in the surrogate chamber for each treatment. Dissolved oxygen (DO), temperature, pH, and salinity were then monitored in the surrogate chambers daily until test termination. Target test parameters were:

| | |
|---|---|
| Dissolved Oxygen: | ≥5.1 mg/L |
| pH: | 7 - 9 units |
| Temperature: | 15 ± 1°C |
| Salinity: | 28 ± 1ppt |

The tests were initiated by randomly allocating 20 *E. estuarius* into each test chamber, ensuring that each of the amphipods successfully buried into the sediment. Amphipods that did not bury within approximately one hour were replaced with healthy amphipods. The 10-day amphipod bioassay was conducted as a static test with no feeding during the exposure period. At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered amphipods transferred into a Petri dish. The number of surviving and dead amphipods was then determined under a dissecting microscope.

A water-only, 4-day reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to any ammonia concentrations that might be present in the sediments.

## 2.5 20-day Juvenile Polychaete Bioassay

The 20-day chronic toxicity test with *N. arenaceodentata* was initiated on December 4, 2015. Test exposures were prepared with approximately 175 mL of sediment placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. The control and reference sediment were tested concurrently with the test treatment. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure overlying and interstitial ammonia and sulfides. The remaining surrogate chamber was used for measuring daily water quality throughout the test, as well as overlying and interstitial ammonia and sulfides at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as $S^{2-}$ were monitored using a HACH DR/2800 Spectrophotometer.

Test chambers were placed in randomly assigned positions in a water bath at 20°C and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Immediately prior to test initiation, water quality parameters were measured. Dissolved oxygen, temperature, pH, and salinity were then monitored in the surrogates daily until test termination. Target test parameters were:

| | |
|---|---|
| Dissolved Oxygen: | ≥4.6 mg/L |
| pH: | 7 - 9 units |
| Temperature: | 20 ± 1°C |
| Salinity: | 28 ± 2 ppt |

The juvenile polychaete test was initiated by randomly allocating five *N. arenaceodentata* into each test chamber, and observing whether each of the worms successfully buried into the sediment. Worms that did not bury within approximately one hour were replaced with healthy worms. The 20-day test was conducted as a static-renewal test, with exchanges of 300 mL of water occurring every third day. *N. arenaceodentata* were fed every other day with 40 mg of TetraMarin® (approximately 8 mg dry weight per worm). At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered worms transferred into a Petri dish. The number of surviving and dead worms was determined. All surviving worms were then transferred to pre-weighed, aluminum foil weigh-boats, and dried in a drying oven at 60°C for approximately 24 hours. Each weigh-boat was removed, cooled in a dessicator, and then weighed on a microbalance to 0.01 mg. Each of the weigh boats was then heated to 550°C for 2 hours in order to determine the ashed weight. Ash-free dry weights (AFDW) were calculated to correct for the influence of sediment grain size differences between treatments. The ashed boats were weighed to 0.01 mg and the ashed weight was subtracted from the dry weight to calculate the AFDW. Both dry weight and AFDW were used to determine individual worm weight and growth rates.

A water-only, 4-day reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to any ammonia concentrations that might be present in the sediments.

## 2.6 Larval Developmental Bioassay

Test sediment was evaluated using the larval benthic toxicity test with the mussel, *M. galloprovincialis*. The mussel larval test was initiated on December 7, 2015. The control and reference sediment were tested with the test treatments. To prepare the test exposures, 18 g (±1 g) of test sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled to 900 mL with 0.45-µm filtered seawater. Six replicate chambers were prepared for the test treatment, reference sediment, and the native sediment control treatment. Five of the replicates were used to evaluate the test; the sixth replicate was used as a water quality surrogate. Each chamber was shaken for 10 seconds and then placed in predetermined randomly-assigned positions in a water bath at 16°C.

To collect gametes for each test, mussels were placed in clean seawater and acclimated at 16°C for approximately 20 minutes. The water bath temperature was then increased over a period of 15 minutes to 20°C. Mussels were held at 20°C and monitored for spawning individuals. Spawning females and males were removed from the water bath and placed in individual containers with seawater. These individuals were allowed to spawn until sufficient gametes were available to initiate the test. After the spawning period, eggs are transferred to fresh seawater and filtered through a 0.5 mm Nitex® mesh screen to remove large debris, feces, and excess gonadal matter. A composite was made of the sperm and diluted with fresh seawater. The fertilization process was initiated by adding sperm to the isolated egg containers. Egg-sperm solutions were periodically homogenized with a perforated plunger during the fertilization process and sub-samples observed under the microscope for egg and sperm viability. Approximately one to one and a half hours after fertilization, embryo solutions were checked for fertilization rate. Only those embryo stocks with >90% fertilization were used to initiate the tests. Embryo solutions were rinsed free of excess sperm and then combined to create one embryo stock solution. Density of the embryo stock solution was determined by counting the number of embryos in a subsample of homogenized stock solution. This was used to determine the volume of embryo stock solution to deliver approximately 20,000 to 40,000 embryos to each test chamber.

Dissolved oxygen, temperature, pH, and salinity were monitored in water quality surrogates to prevent loss or transfer of larvae by adhesion to water-quality probes. Ammonia and sulfides in the overlying water were measured on Day 0 and Day 2 (test termination). Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as $S^{-2}$ were monitored using a HACH DR/2800V Spectrophotometer. Target test parameters were as follows:

| | |
|---|---|
| Dissolved Oxygen: | ≥4.8 mg/L |
| pH: | 7 - 9 units |
| Temperature: | 16 ± 1°C |
| Salinity: | 28 ± 1ppt |

The development test was conducted as a static test without aeration. The protocol calls for test termination when 95% of the embryos in the control have reached the prodissoconch I stage (approximately 48-60 hours). At termination, the overlying seawater was decanted into a clean 1-L jar and mixed with a perforated plunger. From this container, a 10 mL subsample was transferred to a scintillation vial and preserved in 5% buffered formalin. Larvae were subsequently stained with a dilute solution of Rose Bengal in 70% alcohol to help visualization of larvae. The number of normal and abnormal larvae was enumerated on an inverted microscope. Normal larvae included all D-shaped prodissoconch I stage larvae. Abnormal larvae included abnormally shaped prodissoconch I larvae and all early stage larvae.

A water-only reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to ammonia concentrations that would possibly be present in the sediments.

## 2.7 Data Analysis and QA/QC

All water quality and endpoint data were entered into Excel spreadsheets. Water quality parameters were summarized by calculating the mean, minimum, and maximum values for each test treatment. Endpoint data were calculated for each replicate and the mean values and standard deviations were determined for each test treatment.

All hand-entered data was reviewed for data entry errors, which were corrected prior to summary calculations. A minimum of 10% of all calculations and data sorting were reviewed for errors. Review counts were conducted on any apparent outliers.

For the larval test, the percent of normal larvae when compared to the reference was the endpoint used to evaluate the test sediment. This was based on the number of normal larvae in each treatment divided by the number normal in the reference sample, as defined in the SCUM II guidance document (WDOE 2015).

For SMS suitability determinations, comparisons were made according SCUM II (WDOE 2015) and Fox et al. (1998). Data reported as percent mortality or survival were transformed using an arcsine square root transformation prior to statistical analysis. All data were tested for normality using the Wilk-Shapiro test and equality of variance using Levene’s test. Determinations of statistical significance were based on one-tailed Student’s t-tests with an alpha of 0.05. A comparison of the larval endpoint relative to the reference was made using an alpha level of 0.10. For samples failing to meet assumptions of normality, a Mann-Whitney test was conducted to determine significance. For those samples failing to meet the assumptions of normality and equality of variance, a t-test on rankits was used.

# 3 RESULTS

The results of the sediment testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets are provided Appendix A and statistical analyses are provided in Appendix B.

## 3.1 10-day Amphipod Bioassay

The bioassay test with *E. estuarius* was validated with 0% mortality in the native sediment control, which met the performance criterion of ≤10% mortality for SMS evaluations. This result indicates that the test conditions were suitable for adequate amphipod survival. Mean mortality in the reference treatment CR22 was 5% which met the performance criteria (≤25% mortality) and indicated that the reference sediment was acceptable for suitability determination. Mean mortality in the three project samples was 1%. All endpoint results are summarized in Table 3-1.

Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in Table 3-2, Table 3-3, Table 3-4, and Table 3-5.

All water quality parameters were within the acceptable limits throughout the duration of the test, with the exception of minor deviations in temperature and salinity. Temperature was recorded slightly above the targeted range of 15±1°C (Max value 16.5°C). The temperature control system was adjusted upon discovery and temperatures returned to the targeted range for the duration of the test. These deviations would not be expected to affect the significance of the test results.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The $LC_{50}$ value was well within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at Ramboll Environ.

Ammonia concentrations observed in the *E. estuarius* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-3; compare to NOEC of 138 mg/L). Values were also below the published threshold concentration of 15 mg/L total ammonia (Barton 2002). Therefore ammonia concentrations within the sediment samples should not have been a contributor to any adverse biological effects observed in the test treatments. Initial sulfide concentrations in interstitial water were below 0.3 mg/L in all samples except for the reference. Due to the high survival observed in the reference treatment this value was not be expected affect the outcome of the testing.

**Table 3-1. Test Results for *Eohaustorius estuarius*.**

| Treatment | Replicate | Number Initiated | Number Surviving | Percentage Survival | Mean Percentage | | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | Survival | Mortality | |
| Control | 1 | 20 | 20 | 100 | 100 | 0 | 0.0 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |
| CR22 (Reference) | 1 | 20 | 19 | 95 | 95 | 5 | 3.5 |
| | 2 | 20 | 19 | 95 | | | |
| | 3 | 20 | 18 | 90 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 19 | 95 | | | |
| SS1-SS-03_0-12 | 1 | 20 | 20 | 100 | 99 | 1 | 2.2 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 19 | 95 | | | |
| | 5 | 20 | 20 | 100 | | | |
| SS1-SS-05_0-12 | 1 | 20 | 20 | 100 | 99 | 1 | 2.2 |
| | 2 | 20 | 19 | 95 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |
| SS1-SS-06_0-12 | 1 | 20 | 19 | 95 | 99 | 1 | 2.2 |
| | 2 | 20 | 20 | 100 | | | |
| | 3 | 20 | 20 | 100 | | | |
| | 4 | 20 | 20 | 100 | | | |
| | 5 | 20 | 20 | 100 | | | |

**Table 3-2. Water Quality Summary for *Eohaustorius estuarius*.**

| Treatment | Dissolved Oxygen (mg/L) | | | Temperature (°C) | | | Salinity (ppt) | | | pH (units) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max |
| Control | 8.2 | 7.7 | 8.5 | 15.8 | 15.6 | 16.5 | 28 | 28 | 29 | 8.1 | 8.0 | 8.2 |
| CR22 (Reference) | 8.2 | 7.8 | 8.7 | 16.0 | 15.7 | 16.3 | 28 | 28 | 29 | 8.1 | 8.0 | 8.3 |
| SS1-SS-03_0-12 | 8.1 | 7.6 | 8.5 | 15.8 | 15.5 | 16.2 | 29 | 28 | 30 | 8.3 | 8.1 | 8.5 |
| SS1-SS-05_0-12 | 8.1 | 7.5 | 8.6 | 15.9 | 15.7 | 16.2 | 28 | 28 | 29 | 8.2 | 8.0 | 8.5 |
| SS1-SS-06_0-12 | 8.1 | 7.5 | 8.6 | 15.8 | 15.6 | 16.4 | 29 | 28 | 29 | 8.3 | 8.1 | 8.6 |

**Table 3-3. Ammonia Summary for *Eohaustorius estuarius*.**

| Treatment | Overlying Ammonia (mg/L Total) | | Interstitial Ammonia (mg/L Total) | |
|---|---|---|---|---|
| | Day 0 | Day 10 | Day 0 | Day 10 |
| Control | 0.00 | 0.00 | 0.00 | 0.00 |
| CR22 (Reference) | 0.00 | 0.00 | 1.83 | 1.43 |
| SS1-SS-03_0-12 | 0.342 | 0.00 | 5.39 | 1.73 |
| SS1-SS-05_0-12 | 0.872 | 0.00 | 8.79 | 4.35 |
| SS1-SS-06_0-12 | 1.53 | 0.00 | 12.3 | 4.78 |

NOEC (concurrent reference-toxicant test derived) = 138 mg/L

**Table 3-4. Sulfide Summary for *Eohaustorius estuarius*.**

| Treatment | Overlying Sulfides (mg/L) | | Interstitial Sulfides (mg/L) | |
|---|---|---|---|---|
| | Day 0 | Day 10 | Day 0 | Day 10 |
| Control | 0.000 | 0.000 | ND | 0.270 |
| CR22 (Reference) | 0.024 | 0.005 | 1.16 | 0.310 |
| SS1-SS-03_0-12 | 0.041 | 0.000 | 0.119 | 0.168 |
| SS1-SS-05_0-12 | 0.027 | 0.005 | 0.142 | 0.148 |
| SS1-SS-06_0-12 | 0.002 | 0.007 | 0.126 | 0.154 |

ND – no data; insufficient volume for analysis.

**Table 3-5.Test Condition Summary for *Eohaustorius estuarius*.**

| Test Conditions: PSEP *E. estuarius* | | |
|---|---|---|
| Sample Identification | Control, CR22, SS1-SS-03_0-12, SS1-SS-05_0-12, SS1-SS-06_0-12 | |
| Date sampled | October 12, 2015 | |
| Date received | November 30 and December 4, 2015 | |
| Test dates | December 7 – December 17, 2015 | |
| Sample storage conditions | 4°C, dark | |
| Days of holding<br>Recommended: ≤8 weeks (56 days) | 56 Days | |
| Source of control sediment | Yaquina Bay, OR | |
| Test Species | *E. estuarius* | |
| Supplier | Northwestern Aquatic Sciences, Newport, OR | |
| Date acquired | December 4, 2015 | |
| Age class | Mature adult, 3-5 mm | |
| Test Procedures | PSEP 1995 with SMARM revisions | |
| Test location | Ramboll Environ Port Gamble Laboratory | |
| Test type/duration | 10-Day static | |
| Control water | North Hood Canal seawater, 0.45µm filtered | |
| Test dissolved oxygen | Recommended: > 5.1 mg/L | Observed: 7.5 – 8.7 mg/L |
| Test temperature | Recommended: 15 ± 1 °C | Observed: 15.5 – 16.5°C |
| Test Salinity | Recommended: 28 ± 1 ppt | Observed: 28 - 30 ppt |
| Test pH | Recommended: 7 - 9 | Observed: 8.0 – 8.6 |
| Control Performance Standard<br>SMS | Recommended:<br>Control ≤ 10% mortality | Observed: 0% mortality; Pass |
| Reference Performance Standard<br>SMS | Recommended:<br>Reference ≤ 25% mortality | Observed mortality: 5%; Pass |
| Reference Toxicant $LC_{50}$<br>(total ammonia) | $LC_{50}$ = 180.1 mg/L | |
| Mean; Acceptable Range<br>(total ammonia) | 142.1; 35.3 – 248.8 mg/L | |
| NOEC (total ammonia) | 138 mg/L | |
| NOEC (unionized ammonia) | 1.73 mg /L | |
| Test Lighting | 16L:8D with full spectrum lighting per SCUM II Appendix C | |
| Test chamber | 1-Liter Glass Chamber | |
| Replicates/treatment | 5 + 2 surrogates (one used for WQ measurements throughout the test) | |
| Organisms/replicate | 20 | |
| Exposure volume | 175 mL sediment/ 775 mL water | |
| Feeding | None | |
| Water renewal | None | |
| Deviations from Test Protocol | Temperature and Salinity | |

### 3.2 20-day Juvenile Polychaete Bioassay

No mortality was observed in the *N. arenaceodentata* control sediment and mean individual growth (MIG) in the control sediment was 0.902 mg/ind/day (dry weight) and 0.577 mg/ind/day (AFDW). These values fall within the test acceptability criteria of <10% mean mortality and ≥0.38 mg/ind/day (WDOE 2015; Kendall 1996) and ≤10% mean mortality and ≥0.38 mg/ind/day mean individual growth (USACE 2015), indicating that the test conditions were suitable for adequate polychaete survival and growth. A summary of the test results for all samples is shown in Table 3-6. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in Table 3-7, Table 3-8, Table 3-9, and Table 3-10.

Mean mortality in the reference treatment CR22 was 0%, meeting the reference performance standard of ≤10% (WDOE 2015; USACE 2015). Mean individual growth for the reference treatment was 0.694 mg/ind/day (dry weight) and 0.527 mg/ind/day (AFDW). When compared to the control, MIG expressed as AFDW was 91%, which met the reference performance standard of ≥80% (WDOE 2015; USACE 2015).

Mortality in all project sediments was 0%. Mean individual growth (as dry weight) in the test treatments ranged from 0.679 to 0.843 mg/ind/day. Mean individual growth in the AFDW assessment, which removes variability caused by gut contents, ranged from 0.567 to 0.687 mg/ind/day as AFDW. The observed mean growth in the project sediments was greater than or similar to the respective endpoints for the reference treatments in all cases.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The $LC_{50}$ value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at Ramboll Environ.

All water quality parameters were within the acceptable limits throughout the duration of the test, with the exception of minor deviations in salinity. This deviations would not be expected to affect the significance of the test results.

Ammonia concentrations observed in the *N. arenaceodentata* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-8; compare to NOEC of 146 mg/L). Initial sulfide concentrations in interstitial water were below the NOEC (3.4 mg/L; Kendall and Barton 2004) for all samples.

**Table 3-6. Test Results for *Neanthes arenaceodentata*.**

| Treatment | Rep | Number Initiated | Survivors | Mean Mortality (%) | Individual Growth (mg/ind/day) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dry Weight | Mean | Std Dev | AFDW | Mean | Std Dev |
| Control | 1 | 5 | 5 | 0 | 0.785 | 0.902 | 0.100 | 0.485 | 0.577 | 0.083 |
| | 2 | 5 | 5 | | 0.853 | | | 0.626 | | |
| | 3 | 5 | 5 | | 0.859 | | | 0.489 | | |
| | 4 | 5 | 5 | | 1.002 | | | 0.640 | | |
| | 5 | 5 | 5 | | 1.012 | | | 0.646 | | |
| CR22 (Reference) | 1 | 5 | 5 | 0 | 0.884 | 0.694 | 0.108 | 0.714 | 0.527 | 0.110 |
| | 2 | 5 | 5 | | 0.621 | | | 0.496 | | |
| | 3 | 5 | 5 | | 0.670 | | | 0.517 | | |
| | 4 | 5 | 5 | | 0.630 | | | 0.483 | | |
| | 5 | 5 | 5 | | 0.665 | | | 0.427 | | |
| SS1-SS-03_0-12 | 1 | 5 | 5 | 0 | 0.698 | 0.843 | 0.116 | 0.585 | 0.687 | 0.115 |
| | 2 | 5 | 5 | | 0.909 | | | 0.703 | | |
| | 3 | 5 | 5 | | 0.860 | | | 0.688 | | |
| | 4 | 5 | 5 | | 0.989 | | | 0.870 | | |
| | 5 | 5 | 5 | | 0.761 | | | 0.592 | | |
| SS1-SS-05_0-12 | 1 | 5 | 5 | 0 | 0.751 | 0.774 | 0.101 | 0.653 | 0.631 | 0.090 |
| | 2 | 5 | 5 | | 0.803 | | | 0.648 | | |
| | 3 | 5 | 5 | | 0.808 | | | 0.662 | | |
| | 4 | 5 | 5 | | 0.890 | | | 0.715 | | |
| | 5 | 5 | 5 | | 0.617 | | | 0.477 | | |
| SS1-SS-06_0-12 | 1 | 5 | 5 | 0 | 0.668 | 0.679 | 0.064 | 0.569 | 0.567 | 0.044 |
| | 2 | 5 | 5 | | 0.626 | | | 0.537 | | |
| | 3 | 5 | 5 | | 0.738 | | | 0.610 | | |
| | 4 | 5 | 5 | | 0.751 | | | 0.610 | | |
| | 5 | 5 | 5 | | 0.610 | | | 0.511 | | |

**Table 3-7. Water Quality Summary for *Neanthes arenaceodentata*.**

| Treatment | Dissolved Oxygen (mg/L) | | | Temperature (°C) | | | Salinity (ppt) | | | pH (units) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max |
| Control | 7.2 | 6.4 | 7.7 | 19.9 | 19.6 | 20.3 | 30 | 28 | 31 | 7.9 | 7.6 | 8.2 |
| CR22 (Reference) | 7.5 | 6.9 | 8.1 | 19.9 | 19.6 | 20.2 | 29 | 28 | 31 | 8.1 | 7.7 | 8.6 |
| SS1-SS-03_0-12 | 7.3 | 6.8 | 7.7 | 19.8 | 19.5 | 20.2 | 30 | 27 | 32 | 8.3 | 7.9 | 8.6 |
| SS1-SS-05_0-12 | 7.4 | 6.9 | 8.0 | 19.9 | 19.6 | 20.2 | 30 | 28 | 31 | 8.4 | 7.8 | 8.7 |
| SS1-SS-06_0-12 | 7.2 | 6.3 | 7.8 | 19.9 | 19.6 | 20.2 | 30 | 28 | 31 | 8.2 | 7.7 | 8.6 |

**Table 3-8. Ammonia Summary for *Neanthes arenaceodentata*.**

| Treatment | Overlying Ammonia (mg/L Total) | | Interstitial Ammonia (mg/L Total) | |
|---|---|---|---|---|
| | Day 0 | Day 20 | Day 0 | Day 20 |
| Control | 0.126 | 3.98 | 0.638 | 5.77 |
| CR22 (Reference) | 0.000 | 0.000 | 1.37 | 0.760 |
| SS1-SS-03_0-12 | 0.000 | 0.000 | 8.13 | 0.000 |
| SS1-SS-05_0-12 | 1.82 | 0.000 | 9.64 | 0.000 |
| SS1-SS-06_0-12 | 1.84 | 0.000 | 12.3 | 1.11 |

**BOLD**= Exceeds NOEC (concurrent reference-toxicant test derived) of 146 mg/L

**Table 3-9. Sulfide Summary for *Neanthes arenaceodentata*.**

| Treatment | Overlying Sulfides (mg/L Total) | | Interstitial Sulfides (mg/L Total) | |
|---|---|---|---|---|
| | Day 0 | Day 20 | Day 0 | Day 20 |
| Control | 0.000 | 0.018 | 0.200 | 0.085 |
| CR22 (Reference) | 0.006 | 0.069 | 0.055 | 0.305 |
| SS1-SS-03_0-12 | 0.015 | 0.020 | 0.000 | 0.115 |
| SS1-SS-05_0-12 | 0.007 | 0.063 | 0.170 | 0.115 |
| SS1-SS-06_0-12 | 0.002 | 0.015 | 0.155 | 0.225 |

**Table 3-10. Test Condition Summary for *Neanthes arenaceodentata*.**

| Test Conditions: PSEP *N. arenaceodentata* | | |
|---|---|---|
| Sample Identification | Control, CR22, SS1-SS-03_0-12, SS1-SS-05_0-12, SS1-SS-06_0-12 | |
| Date sampled | October 12, 2015 | |
| Date received | November 30 and December 4, 2015 | |
| Test dates | December 4 – December 24, 2015 | |
| Sample storage conditions | 4°C, dark | |
| Days of holding<br>Recommended: ≤8 weeks (56 days) | 53 Days | |
| Source of control sediment | Yaquina Bay, OR | |
| Test Species | *N. arenaceodentata* | |
| Supplier | Aquatic Toxicology Support | |
| Date acquired | December 4, 2015 | |
| Age class | Juvenile; 21 – 26 Days post emergence | |
| Test Procedures | PSEP 1995 with SMARM revisions | |
| Test location | Ramboll Environ Port Gamble Laboratory | |
| Test type/duration | 20-Day static renewal | |
| Control water | North Hood Canal seawater, 0.45µm filtered | |
| Test dissolved oxygen | Recommended: > 4.6 mg/L | Observed: 6.3 – 8.1 mg/L |
| Test temperature | Recommended: 20 ± 1 °C | Observed: 19.5 – 20.3 °C |
| Test Salinity | Recommended: 28 ± 2 ppt | Observed: 27 - 32 ppt |
| Test pH | Recommended: 7 - 9 | Observed: 7.6 – 8.7 |
| Initial biomass | Recommended: 0.5 - 1.0 mg<br>Minimum: 0.25 mg | 0.331 mg; Acceptable |
| Control Performance Standard | Recommended:<br>Control ≤ 10% mortality | Observed: 0% Pass |
| | Recommended: ≥ 0.72 mg/ind/day<br>Minimum: ≥ 0.38 mg/ind/day<br>(as Dry Weight) | Observed:<br>0.902 mg/ind/day; Pass |
| Reference performance standard (SMS) | Recommended: Mortality ≤20%<br>$MIG_{Reference}/MIG_{Control}$ (AFDW) ≥ 80% | CR22: 0%; Pass<br>CR22: 91.3%; Pass |
| Reference Toxicant $LC_{50}$<br>(total ammonia) | $EC_{50}$ = 169.2 mg/L | |
| Mean; Acceptable Range<br>(total ammonia) | 143.4; 59.8 – 227.1 mg/L | |
| NOEC (total ammonia) | 146 mg/L | |
| NOEC (unionized ammonia) | 1.473 mg /L | |
| Test Lighting | 16L:8D with full spectrum lighting per SCUM II Appendix C | |
| Test chamber | 1-Liter Glass Chamber | |
| Replicates/treatment | 5 + 2 surrogates<br>(one used for WQ measurements throughout the test) | |
| Organisms/replicate | 5 | |
| Exposure volume | 175 mL sediment/ 775 mL water | |
| Feeding | 40 mg/jar every other day (8mg/ind every other day) | |
| Water renewal | Water renewed every third day (1/3 volume of exposure chamber) | |
| Deviations from Test Protocol | Salinity | |

### 3.3 Larval Development Bioassay

The larval development test with *M. galloprovincialis* was validated by 97.6% normal survivorship, defined as the mean number of normal larvae within the control divided by the stocking density. This value was within both the SMS acceptability criteria of >70%. A summary of the test results for all samples is shown in Table 3-11. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in Table 3-12, Table 3-13, and Table 3-14.

Mean normal survival of the reference sediment CR22 was 87.4%, which met both the SMS reference acceptability criteria of ≥65%. This is defined as the number of normal larvae in the reference sample divided by the number of normal larvae in the control. The test mean chamber stocking density (measured at test initiation) was 28.0 embryos/mL.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The $LC_{50}$ value was within control chart limits (±2 standard deviations from the laboratory historical mean). Therefore the test organisms used in this study were of similar sensitivity to those previously tested at Ramboll Environ.

All water quality parameters were within the acceptable limits throughout the duration of the test.

Ammonia concentrations observed in the *M. galloprovincialis* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-13; compare to NOEC of 8.03 mg/L). This indicates that ammonia concentrations within the sediment samples should not have been a contributor to any adverse biological effects observed in the test treatments.

**Table 3-11. Test Results for *Mytilus galloprovincialis*.**

| Treatment | Rep | Number Normal | Number Abnormal | Mean # Normal (N) | Std. Dev. | Control Normal Survival $N_C$ / I | Reference Normal Survival Relative to Control $N_R$ / $N_C$ | Performance Standard |
|---|---|---|---|---|---|---|---|---|
| Control | 1 | 270 | 4 | 273.2 | 19.2 | 97.6 | | >0.70; Meets Criterion |
| | 2 | 242 | 6 | | | | | |
| | 3 | 291 | 5 | | | | | |
| | 4 | 277 | 6 | | | | | |
| | 5 | 286 | 8 | | | | | |
| CR22 (Reference) | 1 | 206 | 4 | 238.8 | 32.0 | | 87.4 | ≥0.65; Meets Criterion |
| | 2 | 256 | 6 | | | | | |
| | 3 | 266 | 2 | | | | | |
| | 4 | 264 | 5 | | | | | |
| | 5 | 202 | 3 | | | | | |
| SS1-SS-03_0-12 | 1 | 219 | 3 | 229.2 | 32.8 | See Section 4.3 for Larval Test Suitability Determination | | |
| | 2 | 234 | 5 | | | | | |
| | 3 | 183 | 3 | | | | | |
| | 4 | 274 | 1 | | | | | |
| | 5 | 236 | 2 | | | | | |
| SS1-SS-05_0-12 | 1 | 226 | 2 | 244.6 | 20.7 | | | |
| | 2 | 253 | 3 | | | | | |
| | 3 | 233 | 1 | | | | | |
| | 4 | 234 | 2 | | | | | |
| | 5 | 277 | 2 | | | | | |
| SS1-SS-06_0-12 | 1 | 246 | 0 | 254.0 | 24.5 | | | |
| | 2 | 226 | 2 | | | | | |
| | 3 | 288 | 5 | | | | | |
| | 4 | 241 | 3 | | | | | |
| | 5 | 269 | 1 | | | | | |

I = Mean Initial count (Stocking density); 280.0
$N_C$ = Mean Control Normal
$N_R$ = Mean Reference Normal

**Table 3-12. Water Quality Summary for *Mytilus galloprovincialis*.**

| Treatment | Dissolved Oxygen (mg/L) | | | Temperature (°C) | | | Salinity (ppt) | | | pH (units) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max |
| Control | 7.6 | 7.3 | 7.8 | 16.5 | 16.4 | 16.6 | 28 | 28 | 28 | 7.8 | 7.7 | 8.0 |
| CR22 (Reference) | 6.7 | 6.0 | 7.4 | 16.6 | 16.3 | 16.8 | 28 | 28 | 28 | 7.8 | 7.7 | 7.9 |
| SS1-SS-03_0-12 | 6.2 | 5.6 | 6.9 | 16.5 | 16.3 | 16.9 | 28 | 28 | 28 | 7.9 | 7.8 | 7.9 |
| SS1-SS-05_0-12 | 6.5 | 5.6 | 7.6 | 16.7 | 16.6 | 16.7 | 28 | 28 | 28 | 7.9 | 7.8 | 8.0 |
| SS1-SS-06_0-12 | 6.4 | 5.6 | 7.5 | 16.7 | 16.4 | 16.9 | 28 | 28 | 28 | 7.9 | 7.8 | 8.0 |

**Table 3-13. Ammonia and Sulfide Summary for *Mytilus galloprovincialis*.**

| Treatment | Overlying Ammonia (mg/L Total) | | Overlying Sulfides (mg/L Total) | |
|---|---|---|---|---|
| | Day 0 | Final (Day 2) | Day 0 | Final (Day 2) |
| Control | 0.000 | 0.000 | 0.000 | 0.000 |
| CR22 (Reference) | 0.000 | 0.000 | 0.134 | 0.005 |
| SS1-SS-03_0-12 | 0.000 | 0.000 | 0.098 | 0.000 |
| SS1-SS-05_0-12 | 0.000 | 0.139 | 0.072 | 0.000 |
| SS1-SS-06_0-12 | 0.000 | 0.412 | 0.050 | 0.000 |

NOEC (concurrent reference-toxicant test derived) = 8.03 mg/L

**Table 3-14. Test Condition Summary for *Mytilus galloprovincialis*.**

| **Test Conditions: PSEP *M. galloprovincialis*** | | |
|---|---|---|
| Sample Identification | Control, CR22, SS1-SS-03_0-12, SS1-SS-05_0-12, SS1-SS-06_0-12 | |
| Date sampled | October 12, 2015 | |
| Date received | November 30 and December 4, 2015 | |
| Test dates | December 7 – December 9, 2015 | |
| Sample storage conditions | 4°C, dark | |
| Holding time Recommended: < 8 weeks (56 days) | 56 Days | |
| Test Species | *M. galloprovincialis* | |
| Supplier | Taylor Shellfish, Shelton, Wa | |
| Date acquired | December 4, 2015 | |
| Age class | <3-h old embryos | |
| Test Procedures | PSEP 1995 with SMARM revisions | |
| Test location | Ramboll Environ Port Gamble Laboratory | |
| Test type/duration | 48-60 Hour static test (Actual: 48 hours) | |
| Control water | North Hood Canal sea water, 0.45µm filtered | |
| Test dissolved oxygen | Recommended: > 4.8 mg/L | Observed: 5.6 – 7.8 mg/L |
| Test temperature | Recommended: 16 ± 1 °C | Observed: 16.3 – 16.9 °C |
| Test Salinity | Recommended: 28 ± 1 ppt | Observed: 28 – 28 ppt |
| Test pH | Recommended: 7 - 9 | Observed: 7.7 – 8.0 |
| Stocking Density | Recommended: 20 – 40 embryos/mL | Observed: 28.0 embryos/mL |
| Control performance standard (SMS) | Recommended: Control normal survival $\geq$ 70% | Observed: 97.6%; Pass |
| Reference performance standard (SMS) | Recommended: Reference normal survival relative to control $\geq$ 65% | Observed: 87.4%; Pass |
| Reference Toxicant $LC_{50}$ (total ammonia) | $LC_{50}$ = 10.3 mg/L | |
| Mean; Acceptable Range (total ammonia) | 5.4; 0.22 – 10.5 mg/L | |
| NOEC Combined proportion normal (total ammonia) | 8.03 mg/L | |
| NOEC Combined proportion normal (unionized ammonia) | 0.155 mg /L | |
| Test Lighting | 16L:8D with full spectrum lighting per SCUM II Appendix C | |
| Test chamber | 1-Liter Glass Chamber | |
| Replicates/treatment | 5 + 1 surrogate (used for WQ measurements throughout the test) | |
| Exposure volume | 18 g sediment/ 900 mL water | |
| Feeding | None | |
| Water renewal | None | |
| Deviations from Test Protocol | None | |

# 4 DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology's Sediment Cleanup User's Manual II (SCUM II; WDOE 2015). Comparisons were made for each treatment against the reference sample. Two numerical comparisons were made under SMS, the Sediment Cleanup Objective (SCO) and the Cleanup Screening Level (CSL).

## 4.1 Amphipod Test Suitability Determination

Under the SMS program, a treatment will fail SCO if mean mortality in the test sediment is >25% and the difference between mean mortality in the treatment compared to mean mortality in the reference is statistically significant ($p \leq 0.05$). Treatments fail the CSL if mean mortality in the test treatment >30% relative to the reference sediment and the difference is statistically significant.

Project sediments from the R. G. Haley Site do not fail the SCO and CSL criteria for the amphipod test as shown in Table 3-15.

**Table 3-15. SMS Comparison for *Eohaustorius estuarius*.**

| Treatment | Mean Mortality (%) | Compared To: | Statistically Different than Reference? (P=0.05) | Mortality Comparison to Reference $M_T$-$M_R$ (%) | Fails SCO?[1] > 25 % | Fails CSL?[2] > 30 % |
|---|---|---|---|---|---|---|
| Control | 0.0 | | | | | |
| CR22 | 5.0 | | | | | |
| SS1-SS-03_0-12 | 1.0 | CR22 | No | -4 | No | No |
| SS1-SS-05_0-12 | 1.0 | CR22 | No | -4 | No | No |
| SS1-SS-06_0-12 | 1.0 | CR22 | No | -4 | No | No |

[1]SCO: Statistical Significance and MT >25%
[2]CSL: Statistical Significance and MT-MR >30%
$M_T$ = Treatment Mortality
$M_R$ = Reference Mortality

## 4.2 Juvenile Polychaete Test Suitability Determination

Suitability determinations for the juvenile polychaete test were based on mean individual growth (MIG). A test treatment fails SCO criteria if MIG is statistically lower in the test treatment, relative to the reference, and the ratio of the MIG in the test treatment is <0.70 that of the reference. The treatments will fail CSL criteria if the MIG is significantly lower than the reference treatment and the ratio between the MIG of the treatment and the MIG of the reference is <0.50.

Project sediments from the R. G. Haley Site do not fail the SCO and CSL criteria when evaluated on the dry weight and AFDW basis (Table 3-16).

**Table 3-16. SMS Comparison for *Neanthes arenaceodentata*.**

| Treatment | MIG (mg/ind/day) | Comparison To: | Statistically Less than Reference? (p=0.05) | MIG Relative to Reference $MIG_T/MIG_R$ | Fails SCO?[1] < 0.70 | Fails CSL?[2] < 0.50 |
|---|---|---|---|---|---|---|
| **Dry Weight** | | | | | | |
| Control | 0.902 | | | | | |
| CR22 | 0.694 | | | | | |
| SS1-SS-03_0-12 | 0.843 | CR22 | No | 1.21 | No | No |
| SS1-SS-05_0-12 | 0.774 | CR22 | No | 1.12 | No | No |
| SS1-SS-06_0-12 | 0.679 | CR22 | No | 0.98 | No | No |
| **Ash-Free Dry Weight** | | | | | | |
| Control | 0.577 | | | | | |
| CR22 | 0.527 | | | | | |
| SS1-SS-03_0-12 | 0.687 | CR22 | No | 1.30 | No | No |
| SS1-SS-05_0-12 | 0.631 | CR22 | No | 1.20 | No | No |
| SS1-SS-06_0-12 | 0.567 | CR22 | No | 1.08 | No | No |

[1]SCO: Statistical Significance and $MIG_T/MIG_R$ <70%

[2]CSL: Statistical Significance and $MIG_T/MIG_R$ <50%

$MIG_T$ = Treatment Mean Individual Growth

$MIG_R$ = Reference Mean Individual Growth

## 4.3 Larval Test Suitability Determination

Larval test treatments fail SCO criteria if the number of normal larvae in the test treatment is significantly lower than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.85 of the normal development in the reference. Treatments fail CSL criteria if the number of normal larvae in the test treatment is significantly lower than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.70 of the normal development in the reference after normalizing to the control.

Project sediments from the R. G. Haley Site do not fail the SCO and CSL criteria for larval development (Table 3-17).

**Table 3-17. SMS Comparison for *Mytilus galloprovincialis*.**

| Treatment | Mean Normal Survival (%)[1] | Mean Number Normal | Compared To: | Statistically Less than Reference? (p=0.10) | Fails SCO?[2] <0.85 | Fails CSL?[3] <0.70 |
|---|---|---|---|---|---|---|
| Control | 96.4 | 273 | | | | |
| CR22 | 87.4 | 239 | | | | |
| SS1-SS-03_0-12 | 83.8 | 229 | CR22 | No | No | No |
| SS1-SS-05_0-12 | 89.3 | 245 | CR22 | No | No | No |
| SS1-SS-06_0-12 | 91.9 | 254 | CR22 | No | No | No |

[1] Control data is normalized to the stocking density; reference and project treatments are normalized to the control
[2] SCO: Statistical Significance and ($N_R$-$N_T$) <0.85
[3] CSL: Statistical Significance and ($N_R$-$N_T$) <0.70
$N_T$ =Treatment Mean Number Normal
$N_R$ =Reference Mean Number Normal
$N_C$ =Control Mean Number Normal

# 5 SUMMARY

A summary of the biological tests conducted on the R. G. Haley Site sediments evaluated under the SMS sediment quality criteria (Table 3-18) are provided below.

All project samples pass the SCO and CSL performance criteria for all tests performed on the R. G. Haley Site sediments.

**Table 3-18. Summary of SMS Evaluation.**

| Treatment | Sediment Cleanup Objectives | | | Cleanup Screening Levels | | |
|---|---|---|---|---|---|---|
| | Amphipod | Polychaete | Larval | Amphipod | Polychaete | Larval |
| SS1-SS-03_0-12 | Pass | Pass | Pass | Pass | Pass | Pass |
| SS1-SS-05_0-12 | Pass | Pass | Pass | Pass | Pass | Pass |
| SS1-SS-06_0-12 | Pass | Pass | Pass | Pass | Pass | Pass |

# 6 REFERENCES

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USACE 2015. Dredged Material Evaluation and Disposal Procedures (Users' Manual), Dredged Material Management Program (DMMP). US Army Corps of Engineers-Seattle District; US Environmental Protection Agency (Region 10); Washington State Department of Ecology, and Washington State Department of Natural Resources.

USEPA/USACE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S: -Testing Manual. EPA 823-B-98-004. February 1998.PSEP. 1997. Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Puget Sound Estuary Program. Sampling Chapter. April 1997.

# APPENDICES

# A. LABORATORY DOCUMENTS

# B. STATISTICAL COMPARISONS

# C. CHAIN-OF-CUSTODY FORMS

# APPENDIX A

# LABORATORY DOCUMENTS

***Eohaustorius estuarius* Amphipod Bioassay:**

**Laboratory Data Sheets… A.1.1**

**Reference Toxicant Test… A.1.2**

***Neanthes arenaceodentata* Juvenile Polychaete Bioassay:**

**Laboratory Data Sheets… A.2.1**

**Reference Toxicant Test… A.2.2**

***Mytilus galloprovincialis* Benthic Larval Bioassay:**

**Laboratory Data Sheets… A.3.1**

**Reference Toxicant Test… A.3.2**

# APPENDIX A.1.1

## *Eohaustorius estuarius*

## Amphipod Bioassay

## Laboratory Data Sheets

# ENVIRON

| CLIENT | PROJECT | SPECIES | LABORATORY | PROTOCOL |
|---|---|---|---|---|
| GeoEngineers | RG Haley | *Eohaustorius estuarius* | Port Gamble Bath 7 | PSEP 1995 |
| JOB NUMBER | PROJECT MANAGER | TEST START DATE | TEST END DATE | |
| 0 | B. Hester | 7-Dec-15 | 17-Dec-15 | |

N = Normal
#E = Emergence
#M = Mortality or Molts
G = Growth (fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy

Initial # of Organisms: 20

ENDPOINT DATA AND OBSERVATIONS

| Sample ID | Rep | Jar # | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 | Number Alive | Number Dead Recovered (if any) / Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Date | ~~12/7~~ 12/8 (1) | ~~12/8~~ 12/09 (1) | 12/10 | 12/11 | 12/12 | 12/13 | 12/14 | 12/15 | 12/16 | 12/17 | | |
| | | Tech. | [illegible] | BE JL | [illegible] | JL | JL | JL | [illegible] | [illegible] | [illegible] | MK | | |
| Control | 1 | | N | N | N | N | N | N | N | N | N | N | 20 | |
| | 2 | | | N | | | | | | | | | 20 | |
| | 3 | | | N | | | | | | | | | 20 | |
| | 4 | | | N | | | | | | | | | 20 | |
| | 5 | | | N | | | | | | | | | 20 | |
| CR22 | 1 | | | N | | G | G | G | G | G | G | G | 19 | |
| | 2 | | | | | | | | | | | | 19 | |
| | 3 | | | | | | | | | | | | 18 | |
| | 4 | | | | | | | | | | | | 20 | |
| | 5 | | | | | | | | | | | | 19 | |
| SS1-SS-03-0-12 | 1 | | | | | N | N | | | | | G | 20 | |
| | 2 | | | | | | | | | | | | 20 | |
| | 3 | | | | | 1F | | | | | | | 20 | |
| | 4 | ~~1F~~ (2) | 1F | | | N | | | | | | | 19 | |
| | 5 | | N | | 1F | | | | | | | | 20 | |
| SS1-SS-05-0-12 | 1 | | | | N | | | | | | | G | 20 | |
| | 2 | | | | | | | | | | | | 19 | |
| | 3 | | | | | | | | | | | | 20 | |
| | 4 | | | | | | | | | | | | 20 | |
| | 5 | | | | | | | | | | | | 20 | |

(1) Wrong date [illegible] 12/8 (2) WC. HE 12/08/15.

# ENVIRON

| CLIENT<br>GeoEngineers | PROJECT<br>RG Haley | SPECIES<br>*Eohaustorius estuarius* | LABORATORY<br>Port Gamble Bath 7 | PROTOCOL<br>PSEP 1995 |
|---|---|---|---|---|
| JOB NUMBER<br>0 | PROJECT MANAGER<br>B. Hester | TEST START DATE<br>7-Dec-15 | TEST END DATE<br>17-Dec-15 | |

N = Normal
#E = Emergence
#M = Mortality or Molts
G = Growth (fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy

| Sample ID | Rep | Jar # | Day 1 Date 12/7/15 Tech. | Day 2 Date 12/09 Tech. JL | Day 3 Date 12/10 Tech. | Day 4 Date 12/11 Tech. JL | Day 5 Date 12/12 Tech. JL | Day 6 Date 12/13 Tech. JL | Day 7 Date 12/14 Tech. | Day 8 Date 12/15 Tech. | Day 9 Date 12/16 Tech. | Day 10 Date 12/17 Tech. MK | Number Alive | Number Dead Recovered (if any) / Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial # of Organisms: 20 | | | | | | | | | | | | | | |
| SS1-SS-06-0-12 | 1 | | N | N | N | N | N | G | G | G | G | G | 19 | |
| | 2 | | | | | | | | | | | | 20 | |
| | 3 | | | | | | | | | | | | 20 | |
| | 4 | 1F (2) | 1F | | | | | | | | | | 20 | |
| | 5 | 1F | 1F | 1F | | | 1F | | | | | | 20 | |

(1) WD. TK 12/08/15
(2) WC. TK 12/08/15

# ENVIRON

| CLIENT | PROJECT | SPECIES | | Laboratory / Location | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | *Eohaustorius estuarius* | | Port Gamble / Bath 7 | PSEP 1995 |
| JOB NUMBER | PROJECT MANAGER | TEST START DATE | TIME | TEST END DATE | TIME |
| 0 | B. Hester | 7-Dec-15 | 1520 | 17-Dec-15 | 0900 |

| | | | | WATER QUALITY DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Conditions | DO (mg/L) >5.1 mg/L | | Temperature (°C) 15±1 | | Salinity (ppt) 28±1 | | pH 7 - 9 | | Tech | Date |
| Project ID | Day | Rep | Jar# | meter | mg/L | meter | deg C | meter | ppt | meter | unit | | |
| Control | 0 | WQ | 22 | 8 | 7.9 | 8 | 15.9 | 8 | 28 | 8 | 8.0 | RE | 12/7/15 |
| CR22 | 0 | WQ | 3 | | 7.9 | | 16.2 | | 28 | | 8.0 | RE | 12/7/15 |
| SS1-SS-03-0-12 | 0 | WQ | 16 | | 8.2 | | 15.8 | | 28 | | 8.1 | RE | 12/7/15 |
| SS1-SS-05-0-12 | 0 | WQ | 1 | | 8.1 | | 15.8 | | 28 | | 8.0 | RE | 12/7/15 |
| SS1-SS-06-0-12 | 0 | WQ | 8 | | 8.1 | | 15.9 | | 28 | | 8.1 | RE | 12/7/15 |
| Control | 1 | WQ | 22 | 8 | 8.0 | 8 | 16.5 | 8 | 28 | 8 | 8.0 | BE | 12/8/15 |
| CR22 | 1 | WQ | 3 | 8 | 8.0 | 8 | 16.3 | 8 | 28 | 8 | 8.0 | BE | 12/8/15 |
| SS1-SS-03-0-12 | 1 | WQ | 16 | 8 | ① ~~7~~ 8.1 | 8 | 16.2 | 8 | 28 | 8 | 8.1 | BE | 12/8/15 |
| SS1-SS-05-0-12 | 1 | WQ | 1 | 8 | 7.8 | 8 | 16.2 | 8 | 28 | 8 | 8.1 | BE | 12/8/15 |
| SS1-SS-06-0-12 | 1 | WQ | 8 | 8 | 7.8 | 8 | 16.4 | 8 | 28 | 8 | 8.1 | BE | 12/8/15 |
| Control | 2 | WQ | 22 | 9 | 8.1 | 9 | 15.8 | 9 | 28 | 9 | 8.1 | UL | 12/09/15 |
| CR22 | 2 | WQ | 3 | | 8.0 | | 15.9 | | 28 | | 8.0 | | |
| SS1-SS-03-0-12 | 2 | WQ | 16 | | 8.0 | | 15.6 | | 28 | | 8.1 | | |
| SS1-SS-05-0-12 | 2 | WQ | 1 | | 7.8 | | 15.9 | | 28 | | 8.1 | | |
| SS1-SS-06-0-12 | 2 | WQ | 8 | | 8.0 | | 15.7 | | 28 | | 8.2 | | |
| Control | 3 | WQ | 22 | 9 | ② ~~7.5~~ 7.7 | 9 | 15.6 | 9 | 28 | 9 | ② ~~8.2~~ 8.1 | HK | 12/10/15 |
| CR22 | 3 | WQ | 3 | | 7.8 | | 15.8 | | 28 | | 8.0 | | |
| SS1-SS-03-0-12 | 3 | WQ | 16 | | 7.6 | | 15.7 | | 28 | | 8.1 | | |
| SS1-SS-05-0-12 | 3 | WQ | 1 | | 7.7 | | 15.7 | | 28 | | 8.1 | | |
| SS1-SS-06-0-12 | 3 | WQ | 8 | | 7.5 | | 15.6 | | 28 | | 8.1 | | |

①

② WC HK 12/10/15

# ENVIRON

| CLIENT | PROJECT |
|---|---|
| GeoEngineers | RG Haley |
| JOB NUMBER | PROJECT MANAGER |
| 0 | B. Hester |

| SPECIES | | Laboratory / Location | PROTOCOL |
|---|---|---|---|
| *Eohaustorius estuarius* | | Port Gamble / Bath 7 | PSEP 1995 |
| TEST START DATE | TIME | TEST END DATE | TIME |
| 7-Dec-15 | 1520 | 17-Dec-15 | 0900 |

| | | | Test Conditions | WATER QUALITY DATA: DO (mg/L) >5.1 mg/L | | Temperature (°C) 15±1 | | Salinity (ppt) 28±1 | | pH 7 - 9 | | Tech | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project ID | Day | Rep | Jar# | meter | mg/L | meter | deg C | meter | ppt | meter | unit | | |
| Control | 4 | WQ | 22 | 9 | 8.1 | 9 | 15.6 | 9 | 28 | 9 | 8.1 | JL | 12/11/15 |
| CR22 | 4 | WQ | 3 | | 7.9 | | 15.8 | | 28 | | 8.1 | | |
| SS1-SS-03-0-12 | 4 | WQ | 16 | | 8.0 | | 15.5 | | 29 | | 8.2 | | |
| SS1-SS-05-0-12 | 4 | WQ | 1 | | 7.5 | | 15.8 | | 28 | | 8.1 | | |
| SS1-SS-06-0-12 | 4 | WQ | 8 | | 8.0 | | 15.6 | | 28 | | 8.3 | | |
| Control | 5 | WQ | 22 | 9 | 8.1 | 9 | 15.6 | 9 | 28 | 9 | 8.2 | JL | 12/12 |
| CR22 | 5 | WQ | 3 | | 8.0 | | 15.7 | | 28 | | 8.2 | | |
| SS1-SS-03-0-12 | 5 | WQ | 16 | | 7.9 ~~8.5~~ ① | | 15.7 | | 29 | | 8.3 | | |
| SS1-SS-05-0-12 | 5 | WQ | 1 | | 8.0 | | 15.7 | | 28 | | 8.2 | | |
| SS1-SS-06-0-12 | 5 | WQ | 8 | | 7.9 | | 15.7 | | 28 | | 8.3 | | |
| Control | 6 | WQ | 22 | 8 | 8.3 | 8 | 16.0 | 8 | 29 | 8 | 8.2 | JL | 12/13 |
| CR22 | 6 | WQ | 3 | | 8.3 | | 16.0 | | 28 | | 8.2 | | |
| SS1-SS-03-0-12 | 6 | WQ | 16 | | 8.2 | | 15.9 | | 29 | | 8.3 | | |
| SS1-SS-05-0-12 | 6 | WQ | 1 | | 8.2 | | 15.9 | | 28 | | 8.3 | | |
| SS1-SS-06-0-12 | 6 | WQ | 8 | | 8.2 | | 15.8 | | 29 | | 8.4 | | |
| Control | 7 | WQ | 22 | 8 | ② ~~8.2~~ 8.4 | 8 | 15.8 | 8 | 29 | 8 | ② ~~8.0~~ 8.1 | JL | 12/14 |
| CR22 | 7 | WQ | 3 | | 8.2 | | 15.8 | | 29 | | 8.0 | | |
| SS1-SS-03-0-12 | 7 | WQ | 16 | | 8.4 | | 15.7 | | 29 | | 8.3 | | |
| SS1-SS-05-0-12 | 7 | WQ | 1 | | 8.3 | | 15.9 | | 29 | | 8.2 | | |
| SS1-SS-06-0-12 | 7 | WQ | 8 | | 8.3 | | 15.8 | | 29 | | 8.4 | | |

① MR. JL 12/12/15.  ② WC ~~[illegible]~~ 12/14

# ENVIRON

| CLIENT | PROJECT |
|---|---|
| GeoEngineers | RG Haley |
| JOB NUMBER | PROJECT MANAGER |
| 0 | B. Hester |

| SPECIES | | Laboratory / Location | PROTOCOL |
|---|---|---|---|
| *Eohaustorius estuarius* | | Port Gamble / Bath 7 | PSEP 1995 |
| TEST START DATE | TIME | TEST END DATE | TIME |
| 7-Dec-15 | 1520 | 17-Dec-15 | 0900 |

| | | | | WATER QUALITY DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test Conditions | | | | DO (mg/L) >5.1 mg/L | | Temperature (°C) 15±1 | | Salinity (ppt) 28±1 | | pH 7 - 9 | | Tech | Date |
| Project ID | Day | Rep | Jar# | meter | mg/L | meter | deg C | meter | ppt | meter | unit | | |
| Control | 8 | WQ | 22 | 8 | 8.5 | 8 | 15.9 | 8 | 29 | 8 | ~~8.2~~ 8.1 (2) | HK | 12/15 |
| CR22 | 8 | WQ | 3 | | 8.7 | | 16.0 | | 29 | | (1) ~~8.2~~ 8.2 | | |
| SS1-SS-03-0-12 | 8 | WQ | 16 | | 8.5 | | 15.9 | | 30 | | 8.4 | | |
| SS1-SS-05-0-12 | 8 | WQ | 1 | | 8.5 | | 16.0 | | 29 | | 8.3 | | |
| SS1-SS-06-0-12 | 8 | WQ | 8 | | 8.6 | | 15.9 | | 29 | | 8.5 | | |
| Control | 9 | WQ | 22 | 8 | 8.4 | 8 | 16.0 (3) | 8 | 28 | 8 | 8.1 | HK | 12/16 |
| CR22 | 9 | WQ | 3 | | 8.7 | | 16.2 | | 28 | | 8.3 | | |
| SS1-SS-03-0-12 | 9 | WQ | 16 | | 8.4 | | 16.2 | | 29 | | 8.4 | | |
| SS1-SS-05-0-12 | 9 | WQ | 1 | | 8.5 | | 16.1 | | 28 | | 8.4 | | |
| SS1-SS-06-0-12 | 9 | WQ | 8 | | 8.6 | | 15.9 | | 29 | | 8.5 | | |
| Control | 10 | WQ | 22 | 8 | 8.2 | 8 | 15.6 | 8 | 29 | 8 | 8.1 | JL | 12/17 |
| CR22 | 10 | WQ | 3 | | 8.4 | | 15.8 | | 28 | | 8.3 | | |
| SS1-SS-03-0-12 | 10 | WQ | 16 | | 8.3 | | 15.8 | | 29 | | 8.5 | | |
| SS1-SS-05-0-12 | 10 | WQ | 1 | | 8.6 | | 16.0 | | 28 | | 8.5 | | |
| SS1-SS-06-0-12 | 10 | WQ | 8 | | 8.3 | | 15.7 | | 29 | | 8.6 | | |

(1) Illegible HK 12/15 (2) WC HK 12/15 (3) Bath temp ↓ 0.3°C HK 12/16

# ENVIRON Ammonia and Sulfide Analysis Record



| Client/Project: Geoengineers RG Haley | Organism: Eoh | Test Duration (days): 10 |
|---|---|---|

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY OF TEST: 0

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: ____________

| Calibration Standards Temperature | | Sample temperature should be within ±1°C of standards temperature at time and date of analysis. |
|---|---|---|
| Date: | Temperature: | |
| ~~12~~ 12/7/15 | 19.2 | |

| Sample ID or Description | Conc. or Rep | Date of Sampling and Initials | Ammonia Value (mg/L) | Temp °C | Date of Reading and Initials | Sample Preserved (Y/N) | pH | Sal (ppt) | Sample Volume (mL) | Measured Sulf. (mg/L) | Multi-plier | Calc-ulated Sulf. (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~0~~ pw | Surr | ~~RE~~ 12/7 | 0.00 | 18.2 | 12/7/15 RE | N | 7.5 | (1) ~~20~~ 26.1 | (1) (3) | | | |
| CR-22 pw | | | 1.83 | 18.7 | 12/7/15 RE | | 7.7 | 28 | (2) ~~10~~ 1 | 0.116 | 10 | 1.16 |
| 3 pw | | | 5.39 | 19.1 | 12/7/15 RE | | 7.7 | 29 | (2) ~~1~~ 10 | 0.119 | (2) ~~10~~ | |
| 5 pw | | | 8.79 | 18.9 | 12/7/15 RE | | 7.9 | 29 | 10 | 0.142 | | |
| 6 pw | | | 12.3 | 19.7 | 12/7/15 RE | | 7.9 | 29 | | 0.126 | | |
| ~~0~~ ov | surr | | 0.00 | 19.0 | 12/7/15 AE | N | | | | 0.00 | | |
| CR-22 ov | | | 0.00 | | | | | | | 0.024 | | |
| 3 ov | | | 0.312 | | | | | | | 0.041 | | |
| 5 ov | | | 0.872 | | | | | | | 0.027 | | |
| 6 ov | | | 1.53 | | | | | | | 0.002 | | |

(1) ie RE 12/7/15 (2) IE AE 12/7/15 (3) insufficient pw 12/7/15 AE

# Ammonia and Sulfide Analysis Record



| Client/Project: | Organism: | Test Duration (days): |
|---|---|---|
| GeoEngineers / RG Haley | Eohaustorius estuarius | 10 |

PRETEST / INITIAL / FINAL / OTHER (circle one) — **DAY of TEST:** 10

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments:

| Calibration Standards Temperature | | Sample temperature should be within ±1°C of standards temperature at time and date of analysis. |
|---|---|---|
| **Date:** 12/17/15 | **Temperature:** 18.9°C | |

| Sample ID or Description | Conc. or Rep | Date of Sampling and Initials | Ammonia Value (mg/L) | Temp °C | Date of Reading and Initials | Sample Preserved (Y/N) | pH | Sal (ppt) | Sample Volume (mL) | Measured Sulf. (mg/L) | Multi-plier | Calc-ulated Sulf. (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OV. 0 | Surv. | 12/17/15 JL | 0.00 | 17.9 | 12/17/15 JL | N | | | 10 | 0.000 | NA | NA |
| CR-22 | | | 0.00 | | | | | | | 0.005 | | |
| 3 | | | 0.00 | | | | | | | 0.000 | | |
| 5 | | | 0.00 | | | | | | | 0.005 | | |
| 6 | | | 0.00 | | | | | | | 0.007 | | |
| | | | | | | | | | | | | |
| PW 0 | | 12/17/15 JL | 0.00 | 17.9 | 12/17/15 JL | N | 7.6 | 30 | 1 | 0.027 | 10 | 0.270 |
| CR-22 | | | 1.43 | | | | 7.7 | 29 | 2 | 0.173 | 5 | 0.865① |
| 3 | | | 1.73 | | | | 7.7 | 30 | 5 | 0.084 | 2 | 0.168 |
| 5 | | | 4.35 | | | | 7.9 | 28 | 5 | 0.074 | 2 | 0.148 |
| 6 | | | 9.78 | | | | 7.8 | 30 | 5 | 0.077 | 2 | 0.154 |

① Re-measured w/ blank, 1mL sample · 0.031 × multiplier (10) = 0.310 JL 12/17/15.

# ORGANISM RECEIPT LOG

| | | |
|---|---|---|
| Date: 12/04/15 | Time: 1250 | Batch No. NAS 4744 |
| Organism / Project: Eohs / RG Haley | | |
| Source / Supplier: Northwestern Aquatic Sciences | | |
| No. Ordered: 850 | No. Received: 935 | Source Batch: Collection date, hatch date, etc.): Collected 12/02/15 |
| Condition of Organisms: Good | Approximate Size or Age: (Days from hatch, life stage, size class, etc.): 3-5 mm | |
| Shipper: Fed Ex | B of L (Tracking No.) 8068 0541 4744 | |
| Condition of Container: | Received By: JL | |

| Container | D.O. (mg/L) | Temp. (°C) | Cond. or Sal. (Include Units) | pH (Units) | # Dead | % Dead* | Tech. (Initials) |
|---|---|---|---|---|---|---|---|
| 1 * | — | 7.3 | 22 ppt | — | — | — | JL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

*if >10% contact lab manager

Notes: * Received Dry. Supplier provided Salinity.

## Northwestern Aquatic Sciences

3814 Yaquina Bay Rd., P.O. Box 1437, Newport, OR 97365
Tel: 541-265-7225, Fax: 541-265-2799, www.nwaquatic.com

**SUBJECT: Animal Collection Data Sheet (shipping)**

**SOLD TO: Ramboll Environ**
**Ray**

4729 NE View Dr.
P.O. Box 216
Port Gamble WA 98364

**FedEx# 5507-1540-6**

**Brian Hester/Collin**

360.297.6044
**Mary Bacon**
360.297.6058

**DATE OF SHIPMENT:** 12-3-15

**ANIMAL HISTORY**

| Species | Age/Size | Number Shipped |
|---|---|---|
| *Eohaustorius estuarius* | 3-5mm | 850 + 10% |
| | | |
| | | |

**WATER QUALITY AT TIME OF SHIPMENT**

| | | | |
|---|---|---|---|
| Temperature (°C): 14.3 | pH: 8.0 | Salinity (ppt): 22.0 | D.O. (mg/L): 8.7 |
| Other: | | | |

**PACKAGED BY:** Y. Nakahama **DATE:** 12-3-15

**FIELD COLLECTION/CULTURE NOTES**

Collected 12-2-15 from Yaquina Bay, OR.
Interstitial WQ: Temp: 4.0 °C, Salinity 16.0 ppt.; salinity adjusted up ~5 ppt.
Held at 15°C in aerated water.

**ADDITIONAL COMMENTS**

2-liters of 0.5 mm sieved home sediment included.

**PLEASE RETURN ALL SHIPPING MATERIALS** thank you!

If you have any questions, Please call Gary Buhler or Gerald Irissarri at (541) 265-7225. Thank You.

# APPENDIX A.1.2

## *Eohaustorius estuarius*

## Amphipod Bioassay

## Reference Toxicant Test

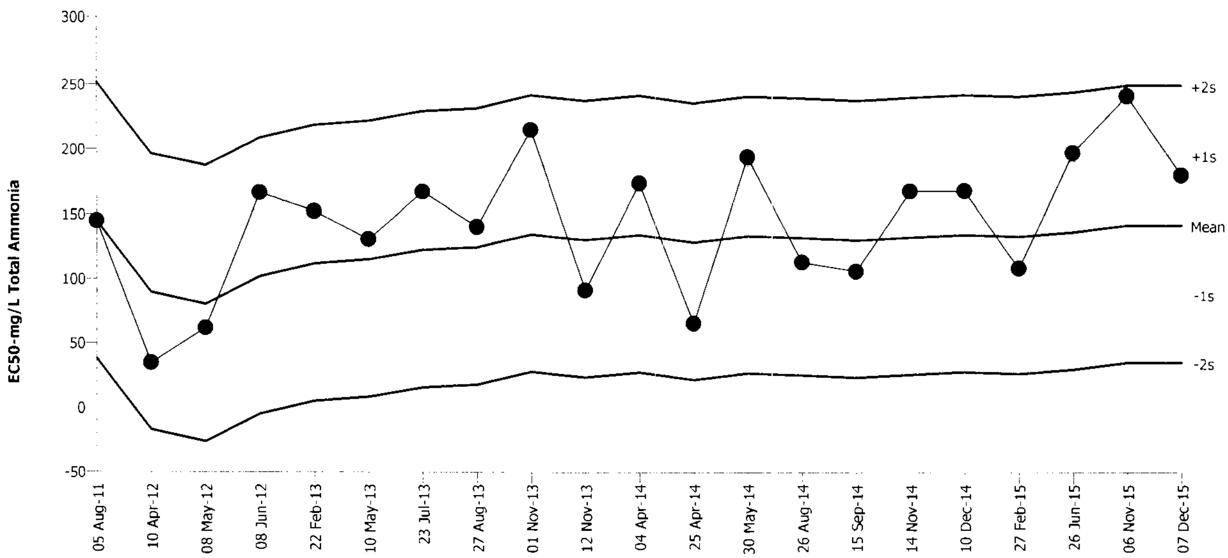
## CETIS QC Plot

**Report Date:** 16 Dec-15 16:11 ( 1 of 1)

**Reference Toxicant 96-h Acute Survival Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Eohaustorius estuarius (Amphipod) | **Material:** | Total Ammonia |
| **Protocol:** | EPA/600/R-94/025 (1994) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |

**Reference Toxicant 96-h Acute Survival Test**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 142.1 | **Count:** | 20 | **-1s Warning Limit:** | 88.67 | **-2s Action Limit:** | 35.28 |
| **Sigma:** | 53.39 | **CV:** | 37.60% | **+1s Warning Limit:** | 195.4 | **+2s Action Limit:** | 248.8 |

**Quality Control Data**

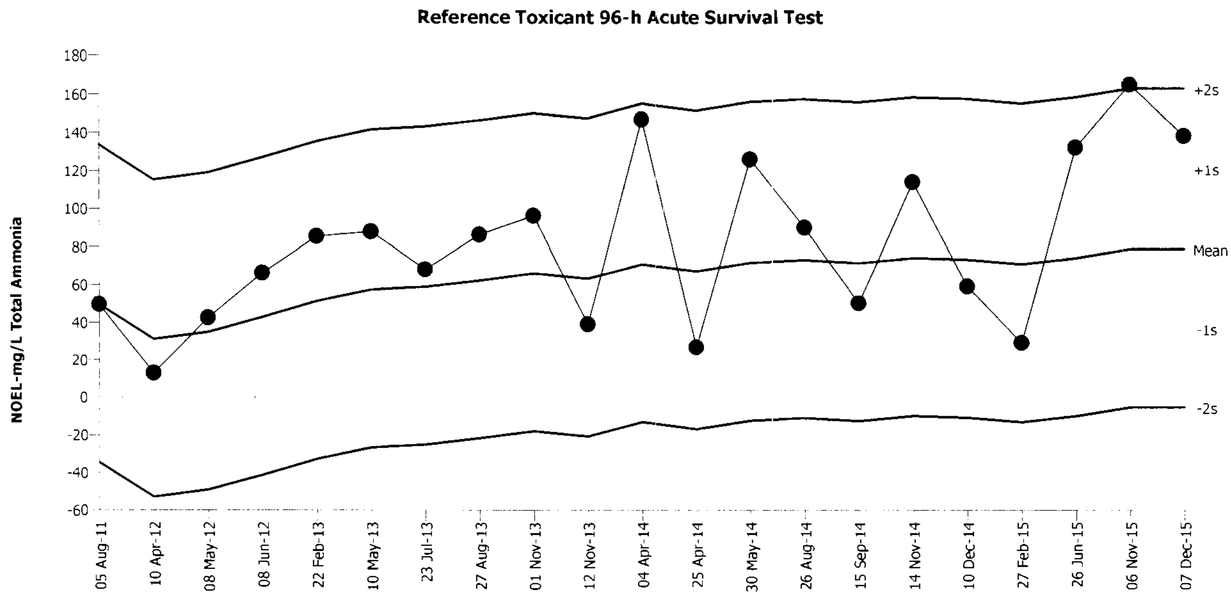
| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2011 | Aug | 5 | 14:35 | 144.9 | 2.759 | 0.05168 | | | 05-3970-3796 | 17-5474-7748 | NewFields |
| 2 | 2012 | Apr | 10 | 15:10 | 34.72 | -107.4 | -2.011 | (-) | (-) | 02-5902-8958 | 20-3951-0452 | NewFields |
| 3 | | May | 8 | 14:30 | 61.87 | -80.23 | -1.503 | (-) | | 20-1853-8108 | 14-9890-9529 | NewFields |
| 4 | | Jun | 8 | 15:30 | 166.5 | 24.39 | 0.4567 | | | 03-4756-9479 | 07-8270-3224 | NewFields |
| 5 | 2013 | Feb | 22 | 11:40 | 152.2 | 10.12 | 0.1895 | | | 09-9358-3146 | 14-0757-4516 | NewFields |
| 6 | | May | 10 | 14:20 | 130.8 | -11.34 | -0.2125 | | | 01-9831-6628 | 02-4493-3987 | NewFields |
| 7 | | Jul | 23 | 15:10 | 167.1 | 25.04 | 0.469 | | | 15-9850-7427 | 05-2897-2730 | NewFields |
| 8 | | Aug | 27 | 12:10 | 140.4 | -1.707 | -0.03197 | | | 20-8540-9997 | 05-1258-2331 | NewFields |
| 9 | | Nov | 1 | 13:30 | 215 | 72.91 | 1.366 | (+) | | 15-9765-5224 | 08-6656-9431 | NewFields |
| 10 | | | 12 | 13:45 | 91.52 | -50.58 | -0.9475 | | | 12-4327-2465 | 06-0504-8497 | NewFields |
| 11 | 2014 | Apr | 4 | 19:15 | 173.9 | 31.75 | 0.5947 | | | 13-5617-0473 | 14-6315-5154 | Port Gamble Environment |
| 12 | | | 25 | 13:00 | 65.78 | -76.32 | -1.43 | (-) | | 11-2394-9115 | 16-6351-0798 | Port Gamble Environment |
| 13 | | May | 30 | 15:30 | 193.9 | 51.82 | 0.9706 | | | 11-1744-7543 | 02-6036-0984 | ENVIRON |
| 14 | | Aug | 26 | 15:45 | 113.3 | -28.78 | -0.539 | | | 15-5557-5937 | 00-0529-4993 | ENVIRON |
| 15 | | Sep | 15 | 15:10 | 106.3 | -35.76 | -0.6697 | | | 07-1282-2061 | 01-5984-9612 | ENVIRON |
| 16 | | Nov | 14 | 14:25 | 168 | 25.9 | 0.485 | | | 09-0717-5355 | 19-7840-9499 | ENVIRON |
| 17 | | Dec | 10 | 15:50 | 168.3 | 26.21 | 0.4908 | | | 19-3485-9112 | 05-9978-3434 | ENVIRON |
| 18 | 2015 | Feb | 27 | 12:35 | 108.8 | -33.3 | -0.6237 | | | 19-3876-5860 | 21-0291-4043 | ENVIRON |
| 19 | | Jun | 26 | 13:20 | 197.1 | 54.99 | 1.03 | (+) | | 00-5720-1886 | 11-7391-9309 | ENVIRON |
| 20 | | Nov | 6 | 15:30 | 240.8 | 98.72 | 1.849 | (+) | | 07-0462-4762 | 05-5994-4603 | ENVIRON |
| 21 | | Dec | 7 | 15:58 | 180.1 | 37.98 | 0.7114 | | | 18-5380-2632 | 01-5604-1684 | ENVIRON |

# CETIS QC Plot



**Reference Toxicant 96-h Acute Survival Test** | **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Eohaustorius estuarius (Amphipod) | **Material:** | Total Ammonia |
| **Protocol:** | EPA/600/R-94/025 (1994) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 78.8 | **Count:** | 20 | **-1s Warning Limit:** | 36.72 | **-2s Action Limit:** | -5.345 |
| **Sigma:** | 42.07 | **CV:** | 53.40% | **+1s Warning Limit:** | 120.9 | **+2s Action Limit:** | 162.9 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2011 | Aug | 5 | 14:35 | 49.6 | -29.2 | -0.6941 | | | 05-3970-3796 | 20-5970-4725 | NewFields |
| 2 | 2012 | Apr | 10 | 15:10 | 13 | -65.8 | -1.564 | (-) | | 02-5902-8958 | 03-7154-8292 | NewFields |
| 3 | | May | 8 | 14:30 | 42.6 | -36.2 | -0.8605 | | | 20-1853-8108 | 20-5519-2940 | NewFields |
| 4 | | Jun | 8 | 15:30 | 66.4 | -12.4 | -0.2947 | | | 03-4756-9479 | 03-6674-9041 | NewFields |
| 5 | 2013 | Feb | 22 | 11:40 | 85.6 | 6.8 | 0.1616 | | | 09-9358-3146 | 06-2817-6220 | NewFields |
| 6 | | May | 10 | 14:20 | 88 | 9.2 | 0.2187 | | | 01-9831-6628 | 03-9560-5903 | NewFields |
| 7 | | Jul | 23 | 15:10 | 68.3 | -10.5 | -0.2496 | | | 15-9850-7427 | 18-8212-0119 | NewFields |
| 8 | | Aug | 27 | 12:10 | 86.4 | 7.6 | 0.1807 | | | 20-8540-9997 | 03-1133-2124 | NewFields |
| 9 | | Nov | 1 | 13:30 | 96.4 | 17.6 | 0.4184 | | | 15-9765-5224 | 03-3609-7670 | NewFields |
| 10 | | | 12 | 13:45 | 39.3 | -39.5 | -0.9389 | | | 12-4327-2465 | 09-6874-0351 | NewFields |
| 11 | 2014 | Apr | 4 | 19:15 | 147 | 68.2 | 1.621 | (+) | | 13-5617-0473 | 16-0396-5073 | Port Gamble Environment |
| 12 | | | 25 | 13:00 | 27 | -51.8 | -1.231 | (-) | | 11-2394-9115 | 19-2434-9439 | Port Gamble Environment |
| 13 | | May | 30 | 15:30 | 126 | 47.2 | 1.122 | (+) | | 11-1744-7543 | 06-3985-7474 | ENVIRON |
| 14 | | Aug | 26 | 15:45 | 90.1 | 11.3 | 0.2686 | | | 15-5557-5937 | 08-3094-4388 | ENVIRON |
| 15 | | Sep | 15 | 15:10 | 50.5 | -28.3 | -0.6727 | | | 07-1282-2061 | 16-3885-0935 | ENVIRON |
| 16 | | Nov | 14 | 14:25 | 114 | 35.2 | 0.8367 | | | 09-0717-5355 | 07-0500-8008 | ENVIRON |
| 17 | | Dec | 10 | 15:50 | 59.4 | -19.4 | -0.4611 | | | 19-3485-9112 | 07-0579-1018 | ENVIRON |
| 18 | 2015 | Feb | 27 | 12:35 | 29.3 | -49.5 | -1.177 | (-) | | 19-3876-5860 | 19-7961-3594 | ENVIRON |
| 19 | | Jun | 26 | 13:20 | 132 | 53.2 | 1.265 | (+) | | 00-5720-1886 | 15-3704-4199 | ENVIRON |
| 20 | | Nov | 6 | 15:30 | 165 | 86.2 | 2.049 | (+) | (+) | 07-0462-4762 | 19-7906-3673 | ENVIRON |
| 21 | | Dec | 7 | 15:58 | 138 | 59.2 | 1.407 | (+) | | 18-5380-2632 | 00-7335-5231 | ENVIRON |

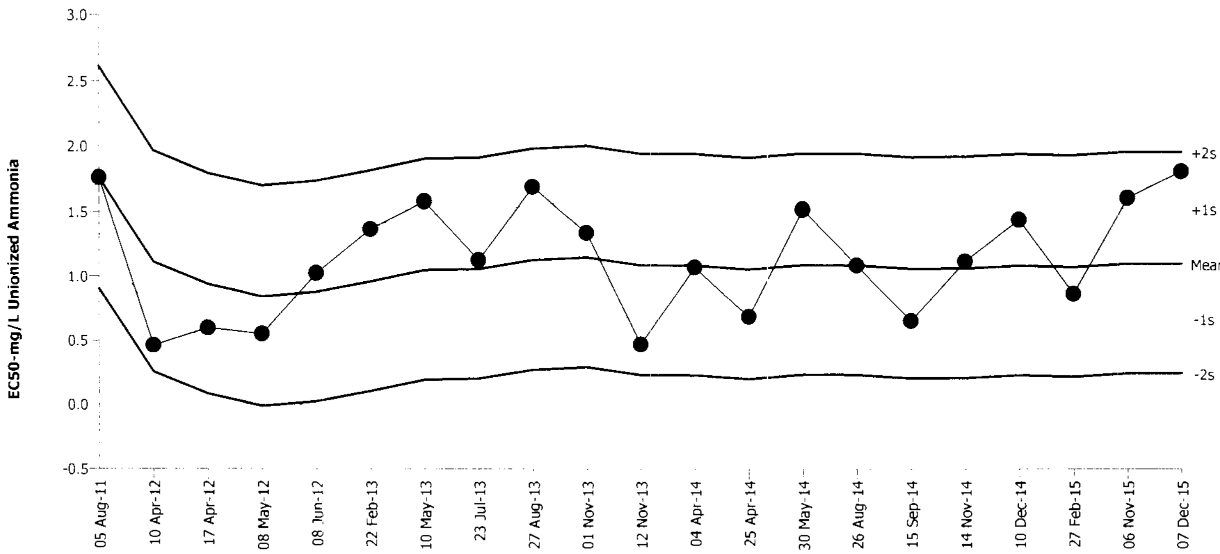
# CETIS QC Plot

**Report Date:** 16 Dec-15 16:16 ( 1 of 1)

**Reference Toxicant 96-h Acute Survival Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Eohaustorius estuarius (Amphipod) | **Material:** | Unionized Ammonia |
| **Protocol:** | EPA/600/R-94/025 (1994) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |

**Reference Toxicant 96-h Acute Survival Test**



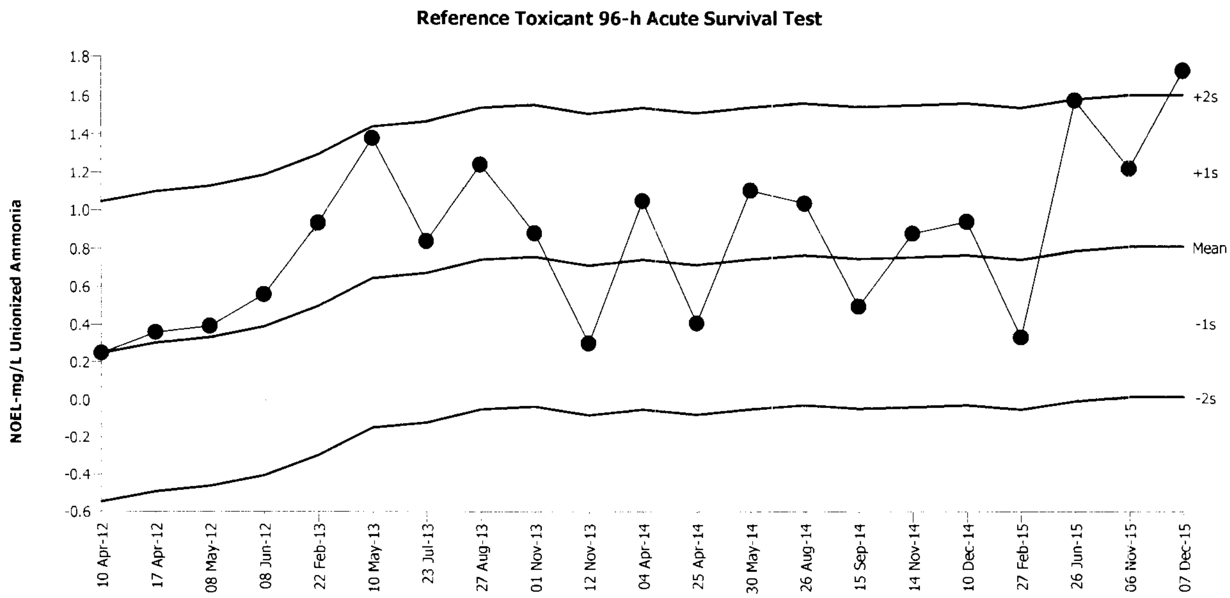

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 1.101 | **Count:** | 20 | **-1s Warning Limit:** | 0.6734 | **-2s Action Limit:** | 0.2462 |
| **Sigma:** | 0.4272 | **CV:** | 38.80% | **+1s Warning Limit:** | 1.528 | **+2s Action Limit:** | 1.955 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2011 | Aug | 5 | 14:35 | 1.76 | 0.6592 | 1.543 | (+) | | 17-9542-0646 | 06-2792-7024 | NewFields |
| 2 | 2012 | Apr | 10 | 15:10 | 0.4636 | -0.6374 | -1.492 | (-) | | 18-7283-5013 | 07-7471-6807 | NewFields |
| 3 | | | 17 | 15:45 | 0.5982 | -0.5028 | -1.177 | (-) | | 18-5229-3668 | 10-4921-5938 | NewFields |
| 4 | | May | 8 | 14:30 | 0.5509 | -0.5501 | -1.288 | (-) | | 15-4565-2403 | 06-1396-7211 | NewFields |
| 5 | | Jun | 8 | 15:30 | 1.024 | -0.07673 | -0.1796 | | | 03-7901-3036 | 07-6844-7156 | NewFields |
| 6 | 2013 | Feb | 22 | 11:40 | 1.364 | 0.2632 | 0.616 | | | 10-3861-9695 | 21-2507-0831 | NewFields |
| 7 | | May | 10 | 14:20 | 1.578 | 0.4768 | 1.116 | (+) | | 05-8857-3753 | 18-2954-4563 | NewFields |
| 8 | | Jul | 23 | 15:10 | 1.126 | 0.02489 | 0.05826 | | | 08-8059-3744 | 12-6137-6954 | NewFields |
| 9 | | Aug | 27 | 12:10 | 1.689 | 0.5883 | 1.377 | (+) | | 18-3860-3992 | 18-0374-3993 | NewFields |
| 10 | | Nov | 1 | 13:30 | 1.339 | 0.2376 | 0.5561 | | | 01-7225-6737 | 09-1642-9045 | NewFields |
| 11 | | | 12 | 13:45 | 0.4715 | -0.6295 | -1.473 | (-) | | 15-7445-3893 | 06-3812-4989 | NewFields |
| 12 | 2014 | Apr | 4 | 19:15 | 1.072 | -0.02935 | -0.06871 | | | 02-4910-1045 | 07-9486-3041 | NewFields |
| 13 | | | 25 | 13:00 | 0.6871 | -0.4139 | -0.9688 | | | 05-3931-3196 | 11-2528-6540 | Port Gamble Environment |
| 14 | | May | 30 | 15:30 | 1.517 | 0.4156 | 0.9728 | | | 03-2348-8477 | 19-6287-3473 | ENVIRON |
| 15 | | Aug | 26 | 15:45 | 1.087 | -0.01396 | -0.03268 | | | 16-9917-4183 | 13-7453-5343 | ENVIRON |
| 16 | | Sep | 15 | 15:10 | 0.6543 | -0.4467 | -1.046 | (-) | | 04-2286-3837 | 03-1229-8693 | ENVIRON |
| 17 | | Nov | 14 | 14:25 | 1.119 | 0.01813 | 0.04244 | | | 07-5753-6828 | 00-1415-6148 | ENVIRON |
| 18 | | Dec | 10 | 15:50 | 1.441 | 0.3396 | 0.7949 | | | 04-0714-3304 | 08-0742-5225 | ENVIRON |
| 19 | 2015 | Feb | 27 | 12:35 | 0.8668 | -0.2342 | -0.5481 | | | 10-1977-7129 | 06-3048-0232 | ENVIRON |
| 20 | | Nov | 6 | 15:30 | 1.605 | 0.5043 | 1.181 | (+) | | 14-1974-2437 | 14-7486-0204 | ENVIRON |
| 21 | | Dec | 7 | 15:58 | 1.807 | 0.7056 | 1.652 | (+) | | 12-1918-7694 | 00-1085-2209 | ENVIRON |

**Reference Toxicant 96-h Acute Survival Test** **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Eohaustorius estuarius (Amphipod) | **Material:** | Unionized Ammonia |
| **Protocol:** | EPA/600/R-94/025 (1994) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 0.8098 | **Count:** | 20 | **-1s Warning Limit:** | 0.412 | **-2s Action Limit:** | 0.0142 |
| **Sigma:** | 0.3978 | **CV:** | 49.10% | **+1s Warning Limit:** | 1.208 | **+2s Action Limit:** | 1.605 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2012 | Apr | 10 | 15:10 | 0.249 | -0.5608 | -1.41 | (-) | | 18-7283-5013 | 17-8032-8770 | NewFields |
| 2 | | | 17 | 15:45 | 0.36 | -0.4498 | -1.131 | (-) | | 18-5229-3668 | 21-3980-0168 | NewFields |
| 3 | | May | 8 | 14:30 | 0.393 | -0.4168 | -1.048 | (-) | | 15-4565-2403 | 07-1675-0393 | NewFields |
| 4 | | Jun | 8 | 15:30 | 0.56 | -0.2498 | -0.628 | | | 03-7901-3036 | 09-3097-7160 | NewFields |
| 5 | 2013 | Feb | 22 | 11:40 | 0.935 | 0.1252 | 0.3147 | | | 10-3861-9695 | 14-6175-2687 | NewFields |
| 6 | | May | 10 | 14:20 | 1.38 | 0.5702 | 1.433 | (+) | | 05-8857-3753 | 12-0577-0060 | NewFields |
| 7 | | Jul | 23 | 15:10 | 0.839 | 0.0292 | 0.0734 | | | 08-8059-3744 | 14-8468-9199 | NewFields |
| 8 | | Aug | 27 | 12:10 | 1.242 | 0.4322 | 1.086 | (+) | | 18-3860-3992 | 13-4279-2307 | NewFields |
| 9 | | Nov | 1 | 13:30 | 0.882 | 0.0722 | 0.1815 | | | 01-7225-6737 | 17-4499-2761 | NewFields |
| 10 | | | 12 | 13:45 | 0.302 | -0.5078 | -1.277 | (-) | | 15-7445-3893 | 14-8429-9092 | NewFields |
| 11 | 2014 | Apr | 4 | 19:15 | 1.05 | 0.2402 | 0.6038 | | | 02-4910-1045 | 18-6624-7464 | NewFields |
| 12 | | | 25 | 13:00 | 0.409 | -0.4008 | -1.008 | (-) | | 05-3931-3196 | 00-2785-8568 | Port Gamble Environment |
| 13 | | May | 30 | 15:30 | 1.105 | 0.2952 | 0.7421 | | | 03-2348-8477 | 17-7984-3461 | ENVIRON |
| 14 | | Aug | 26 | 15:45 | 1.037 | 0.2272 | 0.5711 | | | 16-9917-4183 | 01-4278-7622 | ENVIRON |
| 15 | | Sep | 15 | 15:10 | 0.497 | -0.3128 | -0.7863 | | | 04-2286-3837 | 01-4675-9354 | ENVIRON |
| 16 | | Nov | 14 | 14:25 | 0.881 | 0.0712 | 0.179 | | | 07-5753-6828 | 01-5478-5022 | ENVIRON |
| 17 | | Dec | 10 | 15:50 | 0.943 | 0.1332 | 0.3348 | | | 04-0714-3304 | 12-5251-7122 | ENVIRON |
| 18 | 2015 | Feb | 27 | 12:35 | 0.334 | -0.4758 | -1.196 | (-) | | 10-1977-7129 | 04-0485-4050 | ENVIRON |
| 19 | | Jun | 26 | 13:20 | 1.578 | 0.7682 | 1.931 | (+) | | 13-7504-6588 | 11-4090-1553 | ENVIRON |
| 20 | | Nov | 6 | 15:30 | 1.22 | 0.4102 | 1.031 | (+) | | 14-1974-2437 | 10-4251-0205 | ENVIRON |
| 21 | | Dec | 7 | 15:58 | 1.733 | 0.9232 | 2.321 | (+) | (+) | 12-1918-7694 | 05-5204-9536 | ENVIRON |

# CETIS Summary Report

| | | | |
|---|---|---|---|
| **Report Date:** | 16 Dec-15 16:10 (p 1 of 1) | **Test Code:** | 6E7EC888 \| 18-5380-2632 |

**Reference Toxicant 96-h Acute Survival Test** **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Batch ID:** | 15-6483-7423 | **Test Type:** | Survival | **Analyst:** | |
| **Start Date:** | 07 Dec-15 15:58 | **Protocol:** | EPA/600/R-94/025 (1994) | **Diluent:** | Laboratory Seawater |
| **Ending Date:** | 11 Dec-15 14:35 | **Species:** | Eohaustorius estuarius | **Brine:** | Not Applicable |
| **Duration:** | 95h | **Source:** | Northwestern Aquatic Science, OR | **Age:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sample ID:** | 04-1097-4320 | **Code:** | 187EF870 | **Client:** | Internal Lab |
| **Sample Date:** | 05 May-14 | **Material:** | Total Ammonia | **Project:** | Reference Toxicant |
| **Receive Date:** | 05 May-14 | **Source:** | Reference Toxicant | | |
| **Sample Age:** | 581d 16h | **Station:** | p140505.221 | | |

**Comparison Summary**

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 00-7335-5231 | Proportion Survived | 138 | 243 | 183.1 | 8.44% | | Dunnett Multiple Comparison Test |

**Point Estimate Summary**

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 01-5604-1684 | Proportion Survived | EC50 | 180.1 | 168.6 | 192.4 | | Trimmed Spearman-Kärber |

**Proportion Survived Summary**

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 20.5 | | 3 | 0.9667 | 0.8232 | 1 | 0.9 | 1 | 0.03333 | 0.05774 | 5.97% | 3.33% |
| 37.4 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 74.2 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 138 | | 3 | 0.9333 | 0.7899 | 1 | 0.9 | 1 | 0.03333 | 0.05774 | 6.19% | 6.67% |
| 243 | | 3 | 0.03333 | 0 | 0.1768 | 0 | 0.1 | 0.03333 | 0.05774 | 173.2% | 96.67% |

**Proportion Survived Detail**

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 20.5 | | 1 | 1 | 0.9 |
| 37.4 | | 1 | 1 | 1 |
| 74.2 | | 1 | 1 | 1 |
| 138 | | 1 | 0.9 | 0.9 |
| 243 | | 0 | 0.1 | 0 |

**Proportion Survived Binomials**

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 10/10 | 10/10 | 10/10 |
| 20.5 | | 10/10 | 10/10 | 9/10 |
| 37.4 | | 10/10 | 10/10 | 10/10 |
| 74.2 | | 10/10 | 10/10 | 10/10 |
| 138 | | 10/10 | 9/10 | 9/10 |
| 243 | | 0/10 | 1/10 | 0/10 |

# CETIS Test Data Worksheet

**Report Date:** 16 Dec-15 16:10 (p 1 of 1)
**Test Code:** 18-5380-2632/6E7EC888

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Start Date:** | 07 Dec-15 15:58 | **Species:** | Eohaustorius estuarius | **Sample Code:** | 187EF870 |
| **End Date:** | 11 Dec-15 14:35 | **Protocol:** | EPA/600/R-94/025 (1994) | **Sample Source:** | Reference Toxicant |
| **Sample Date:** | 05 May-14 | **Material:** | Total Ammonia | **Sample Station:** | p140505.221 |

| C-mg/L | Code | Rep | Pos | # Exposed | # Survived | Notes |
|---|---|---|---|---|---|---|
| 0 | D | 1 | 1 | 10 | 10 | |
| 0 | D | 2 | 2 | 10 | 10 | |
| 0 | D | 3 | 3 | 10 | 10 | |
| 20.5 | | 1 | 4 | 10 | 10 | |
| 20.5 | | 2 | 5 | 10 | 10 | |
| 20.5 | | 3 | 6 | 10 | 9 | |
| 37.4 | | 1 | 7 | 10 | 10 | |
| 37.4 | | 2 | 8 | 10 | 10 | |
| 37.4 | | 3 | 9 | 10 | 10 | |
| 74.2 | | 1 | 10 | 10 | 10 | |
| 74.2 | | 2 | 11 | 10 | 10 | |
| 74.2 | | 3 | 12 | 10 | 10 | |
| 138 | | 1 | 13 | 10 | 10 | |
| 138 | | 2 | 14 | 10 | 9 | |
| 138 | | 3 | 15 | 10 | 9 | |
| 243 | | 1 | 16 | 10 | 0 | |
| 243 | | 2 | 17 | 10 | 1 | |
| 243 | | 3 | 18 | 10 | 0 | |

# CETIS Summary Report



**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Batch ID:** | 13-8402-0771 | **Test Type:** | Survival | **Analyst:** | |
| **Start Date:** | 07 Dec-15 15:58 | **Protocol:** | EPA/600/R-94/025 (1994) | **Diluent:** | Laboratory Seawater |
| **Ending Date:** | 11 Dec-15 14:35 | **Species:** | Eohaustorius estuarius | **Brine:** | Not Applicable |
| **Duration:** | 95h | **Source:** | Northwestern Aquatic Science, OR | **Age:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sample ID:** | 21-0513-7019 | **Code:** | 7D79D77B | **Client:** | Internal Lab |
| **Sample Date:** | 05 May-14 | **Material:** | Unionized Ammonia | **Project:** | Reference Toxicant |
| **Receive Date:** | 05 May-14 | **Source:** | Reference Toxicant | | |
| **Sample Age:** | 581d 16h | **Station:** | p140505.221 | | |

### Comparison Summary

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 05-5204-9536 | Proportion Survived | 1.733 | 1.906 | 1.817 | 8.44% | | Dunnett Multiple Comparison Test |

### Point Estimate Summary

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 00-1085-2209 | Proportion Survived | EC50 | 1.807 | 1.757 | 1.857 | | Trimmed Spearman-Kärber |

### Proportion Survived Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.399 | | 3 | 0.9667 | 0.8232 | 1 | 0.9 | 1 | 0.03333 | 0.05774 | 5.97% | 3.33% |
| 0.734 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.161 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.733 | | 3 | 0.9333 | 0.7899 | 1 | 0.9 | 1 | 0.03333 | 0.05774 | 6.19% | 6.67% |
| 1.906 | | 3 | 0.03333 | 0 | 0.1768 | 0 | 0.1 | 0.03333 | 0.05774 | 173.2% | 96.67% |

### Proportion Survived Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 0.399 | | 1 | 1 | 0.9 |
| 0.734 | | 1 | 1 | 1 |
| 1.161 | | 1 | 1 | 1 |
| 1.733 | | 1 | 0.9 | 0.9 |
| 1.906 | | 0 | 0.1 | 0 |

### Proportion Survived Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 10/10 | 10/10 | 10/10 |
| 0.399 | | 10/10 | 10/10 | 9/10 |
| 0.734 | | 10/10 | 10/10 | 10/10 |
| 1.161 | | 10/10 | 10/10 | 10/10 |
| 1.733 | | 10/10 | 9/10 | 9/10 |
| 1.906 | | 0/10 | 1/10 | 0/10 |

# CETIS Test Data Worksheet

Report Date: 16 Dec-15 16:15 (p 1 of 1)
Test Code: 12-1918-7694/48AB53EE

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

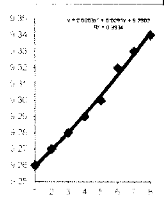
| | | | | | |
|---|---|---|---|---|---|
| **Start Date:** | 07 Dec-15 15:58 | **Species:** | Eohaustorius estuarius | **Sample Code:** | 7D79D77B |
| **End Date:** | 11 Dec-15 14:35 | **Protocol:** | EPA/600/R-94/025 (1994) | **Sample Source:** | Reference Toxicant |
| **Sample Date:** | 05 May-14 | **Material:** | Unionized Ammonia | **Sample Station:** | p140505.221 |

| C-mg/L | Code | Rep | Pos | # Exposed | # Survived | Notes |
|---|---|---|---|---|---|---|
| 0 | D | 1 | 1 | 10 | 10 | |
| 0 | D | 2 | 2 | 10 | 10 | |
| 0 | D | 3 | 3 | 10 | 10 | |
| 0.399 | | 1 | 4 | 10 | 10 | |
| 0.399 | | 2 | 5 | 10 | 10 | |
| 0.399 | | 3 | 6 | 10 | 9 | |
| 0.734 | | 1 | 7 | 10 | 10 | |
| 0.734 | | 2 | 8 | 10 | 10 | |
| 0.734 | | 3 | 9 | 10 | 10 | |
| 1.161 | | 1 | 10 | 10 | 10 | |
| 1.161 | | 2 | 11 | 10 | 10 | |
| 1.161 | | 3 | 12 | 10 | 10 | |
| 1.733 | | 1 | 13 | 10 | 10 | |
| 1.733 | | 2 | 14 | 10 | 9 | |
| 1.733 | | 3 | 15 | 10 | 9 | |
| 1.906 | | 1 | 16 | 10 | 0 | |
| 1.906 | | 2 | 17 | 10 | 1 | |
| 1.906 | | 3 | 18 | 10 | 0 | |

| | | | |
|---|---|---|---|
| CLIENT: | GeoEngineers | Date of Test: | 07-Dec-15 |
| PROJECT: | RG Haley | Test Type: | Eoh RT |
| COMMENTS: | P140505.221 | | |

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

| Integer: | I-factor |
|---|---|
| 1 | 9.26 |
| 2 | 9.27 |
| 3 | 9.28 |
| 4 | 9.29 |
| 5 | 9.30 |
| 6 | 9.32 |
| 7 | 9.33 |
| | 9.34 |



| | Sample | Mod | *NH3T (mg/L)* | *salinity (ppt)* | *pH* | *temp (C)* | temp (K) | i-factor | Mod | NH3U (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Target / Sample Name | | Actual | 22.9 | 8.0 | 24.1 | 297.26 | 9.3053 | | **#VALUE!** |
| | Example 3.5 | | 2.000 | 10.0 | 7.5 | 5.0 | 278.16 | 9.2750 | | **0.008** |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | 15 | | 20.5 | 28 | 7.9 | 16.1 | 289.26 | 9.3187 | | **0.399** |
| 5 | 30 | | 37.4 | 28 | 7.9 | 16.2 | 289.36 | 9.3187 | | **0.734** |
| 6 | 60 | | 74.2 | 28 | 7.8 | 16.2 | 289.36 | 9.3187 | | **1.161** |
| 7 | 120 | | 138 | 28 | 7.7 | 16.3 | 289.46 | 9.3187 | | **1.733** |
| 8 | 240 | | 243 | 28 | 7.5 | 16.1 | 289.26 | 9.3187 | | **1.906** |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 36 | | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | | | | | | | | | | |

# Ammonia Reference Toxicant Test Water Quality Data Sheet

| CLIENT | PROJECT | | Laboratory | PROTOCOL |
|---|---|---|---|---|
| GeoEngineers | RG Haley | *Eohaustorius estuarius* | Port Gamble . | PSEP 1995 |

| TEST ID | LOT #: | TEST START DATE | TIME | 4-DAY END DATE | TIME |
|---|---|---|---|---|---|
| P140505.221 | 3244C535 | ① ~~04~~ 07Dec15 | 1558 | ① ~~08~~ 11Dec15 | 1435 |

| CHAMBER SIZE/TYPE | EXPOSURE VOLUME |
|---|---|
| glass pint jar | 250 mL |

## WATER QUALITY DATA

| TEST CONDITIONS | | | | | DO (mg/L) | | TEMP(C) | | SAL (ppt) | | pH | | TECHNICIAN | AMMONIA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | > 5.1 | | 15 ± 1 | | 28 ± 2 | | 7--9 | | | | | | | | |
| SAMPLE ID | CONCENTRATION | | DAY | REP | D.O. | | TEMP. | | SALINITY | | pH | | WQ TECH/ DATE | AMMONIA | | Tech | | | |
| | value | units | | | meter | mg/L | meter | °C | meter | ppt | meter | unit | | METER | mg/L | | | | |
| Ref.Tox.-ammonia | 0 | mg/L | 0 | Stock | 8 | 7.9 | 8 | ② 16.2 ~~16.4~~ | 8 | 28 | 8 | 8.0 | RE 12/7/15 | 3 | 0.00 | | | | |
| | | | 4 | 1 | 9 | 7.4 | 9 | 15.6 | 9 | 28 | 9 | 7.9 | JL 12/11 | | | | | | |
| Ref.Tox.-ammonia | 15 | mg/L | 0 | Stock | 8 | 8.0 | 8 | ② 16.1 ~~16.5~~ | 8 | 28 | 8 | 7.9 | RE 12/7/15 | 3 | 20.5 | | | | |
| | | | 4 | 1 | 9 | 7.5 | 9 | 15.3 | 9 | 28 | 9 | 8.0 | JL 12/11 | | | | | | |
| Ref.Tox.-ammonia | 30 | mg/L | 0 | Stock | 8 | 8.0 | 8 | ② 16.2 ~~16.5~~ | 8 | 28 | 8 | 7.9 | RE 12/7/15 | 3 | 37.4 | | | | |
| | | | 4 | 1 | 9 | 7.5 | 9 | 15.3 | 9 | 28 | 9 | 8.0 | JL 12/11 | | | | | | |
| Ref.Tox.-ammonia | 60 | mg/L | 0 | Stock | 8 | 8.0 | 8 | ② 16.2 ~~16.6~~ | 8 | 28 | 8 | 7.8 | RE 12/7/15 | 3 | 74.2 | | | | |
| | | | 4 | 1 | 9 | 7.6 | 9 | 15.2 | 9 | 28 | 9 | 7.9 | JL 12/11 | | | | | | |
| Ref.Tox.-ammonia | 120 | mg/L | 0 | Stock | 8 | 8.0 | 8 | ② 16.3 ~~17.1~~ | 8 | 28 | 8 | 7.7 | RE 12/7/15 | 3 | 138 | | | | |
| | | | 4 | 1 | 9 | 7.4 | 9 | 15.2 | 9 | 28 | 9 | 7.9 | JL 12/11 | | | | | | |
| Ref.Tox.-ammonia | 240 | mg/L | 0 | Stock | 8 | 7.9 | 8 | ② 16.1 ~~17.0~~ | 8 | 28 | 8 | 7.5 | RE 12/7/15 | 3 | 243 | | | | |
| | | | 4 | 1 | 9 | 7.5 | 9 | 15.3 | 9 | 28 | 9 | 7.9 | JL 12/11 | | | | | | |

① IE. JL 12/06/15
② IE RE 12/7/15

# Ammonia Re     ›nce Toxicant Test Water Qu⁻ˡity Data Sheet

| CLIENT | PROJECT | SPECIES | | |
|---|---|---|---|---|
| | | *Eohaustorius estuarius* | | |
| | | PROJECT MANAGER | LABORATORY | PROTOCOL |
| GeoEngineers | RG Haley | B. Hester | Port Gamble . | PSEP 1995 |

## SURVIVAL & BEHAVIOR DATA

**OBSERVATION KEY**
- N = Normal
- LOE = Loss of equilibium
- Q = Quinscent
- DC = Discoloration
- NB = No body
- F = Floating on surface

INITIAL # OF ORGANISMS: 10

| | | | | | DAY 1 | | | DAY 2 | | | DAY 3 | | | DAY 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE 12/8/15 | | | DATE 12/09 | | | DATE [illegible] | | | DATE 12/11 | | |
| | | | | | TECHNICIAN [illegible] | | | TECHNICIAN JL | | | TECHNICIAN [illegible] | | | TECHNICIAN JL | | |
| SAMPLE ID | CONC. value | CONC. units | REP | INITIAL NUMBER | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS |
| Ref.Tox.- Ammonia | 0 | mg/L | 1 | | 10 | 0 | 3F | 10 | 0 | 3F | 10 | 0 | 1F | 10 | 0 | 1F |
| | | | 2 | | 10 | 0 | N | 10 | 0 | N | 10 | 0 | [illegible] | 10 | 0 | N |
| | | | 3 | | 10 | 0 | 2F | 10 | 0 | 3F | 10 | 0 | 2F | 10 | 0 | 2F |
| Ref.Tox.- Ammonia | 15 | mg/L | 1 | | 10 | 0 | 2F | 10 | 0 | 4F | 10 | 0 | 2F | 10 | 0 | 1F |
| | | | 2 | | 10 | 0 | 2F | 10 | 0 | 1F | 10 | 0 | 1F | 10 | 0 | 2F |
| | | | 3 | | 10 | 0 | 3F | 10 | 0 | 3F | 10 | 0 | 2F | 9 | 1 | 3F |
| Ref.Tox.- Ammonia | 30 | mg/L | 1 | | 10 | 0 | 1F | 10 | 0 | 1F | 10 | 0 | 2F | 10 | 0 | N |
| | | | 2 | | 10 | 0 | 3F | 10 | 0 | 3F | 10 | 0 | 3F | 10 | 0 | 1F |
| | | | 3 | | 10 | 0 | N | 10 | 0 | 1F | 10 | 0 | 1F | 10 | 0 | 1F |
| Ref.Tox.- Ammonia | 60 | mg/L | 1 | | 10 | 0 | 3F | 10 | 0 | 3F | 10 | 0 | 1F | 10 | 0 | N |
| | | | 2 | | 10 | 0 | 3F | 10 | 0 | 4F | 10 | 0 | 5F | 10 | 0 | 2F |
| | | | 3 | | 10 | 0 | 3F | 10 | 0 | 2F | 10 | 0 | 2F | 10 | 0 | 2F |
| Ref.Tox.- Ammonia | 120 | mg/L | 1 | | 10 | 0 | 3F | 10 | 0 | 2F | 10 | 0 | 2F | 10 | 0 | 2F |
| | | | 2 | | 10 | 0 | 3F | 10 | 0 | N | 10 | 0 | N | 9 | 1 | N |
| | | | 3 | | 10 | 0 | 4F | 10 | 0 | 4F | 10 | 0 | 4F | 9 | 1 | 2F |
| Ref.Tox.- Ammonia | 240 | mg/L | 1 | | 10 | 0 | 3F,Q | 6 | 4 | Θ | 4 | 2 | Θ | 0 | 4 | Θ |
| | | | 2 | | 10 | 0 | 4F,Q | 6 | 4 | Θ | 5 | 1 | | 1 | 4 | |
| | | | 3 | | 10 | 0 | 2F,Q | 7 | 3 | Θ | 4 | 3 | | 0 | 4 | |

ENVIRON **Ammonia Reference Toxicant Spiking Worksheet**

**Reference Toxicant ID:** P140505.221
**Date Prepared:** 12/7/15
**Technician Initials:** HE

# Amp/Eoh $NH_3$ RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 12/7/2015
Measurement: 9286.6

| Test Solutions | | | Volume of stock to reach desired concentration | |
|---|---|---|---|---|
| **Measured Concentration** | **Desired Concentration** | **Volume** | | |
| mg/L | mg/L | mL | mL stock to increase | |
| | | | [redacted] | SALT WATER |
| 243 ~~320~~ ① | **240** | 750 | | **29.074** |
| 138 | **120** | 750 | | **14.537** |
| 74.2 | **60** | 750 | | **7.269** |
| 37.4 | **30** | 750 | | **3.634** |
| 20.5 | **15** | 750 | | **1.817** |
| | **0** | 750 | | **0.000** |
| | | | | |
| | | | | |

① IE HE 12/7

# APPENDIX A.2.1

## *Neanthes arenaceodentata*

## Juvenile Polychaete Bioassay

## Laboratory Data Sheets

| CLIENT | PROJECT | JOB NO. | PROJECT MANAGER | LABORATORY / LOCATION | PROTOCOL | SPECIES |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

ENDPOINT DATA & OBSERVATIONS

| Sample | Rep | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date / Initials | | 12/05 JL | 12/06 JL | 12/7 [illegible] | 12/8 [illegible] | 12/09 JL | 12/10 [illegible] | 12/11 JL | 12/12 JL | 12/13 JL | 12/14 [illegible] | 12/15 [illegible] | 12/16 [illegible] | 12/17 JL | 12/18 [illegible] | 12/19 JL | 12/20 JL | 12/21 [illegible] | 12/22 [illegible] | 12/23 [illegible] | 12/24 JL | | | | |
| Control / | 1 | N | N | N | N | N | N | N | N | N | N | U | N | N | N | N | N | N | N | – | G | 5 | [1] 191.54 | 271.70 | ~~221.99~~ 222.02 ~~236.09~~ ① |
| | 2 | | | | | | | | | | G | G | G | G | G | G | G | G | G | | | 5 | [2] 212.92 | 299.89 | 236.09 |
| | 3 | | | | | | | | | | N | N | | | | | | | | | | 5 | [3] 203.89 | 291.47 | 241.38 |
| | 4 | | | | | | | | | | | L | | | | | | | | | | 5 | [4] 212.09 | 313.93 | 248.68 |
| | 5 | | | | | | | | | | | G | | | | | | | | | | 5 | [5] 205.64 | 308.47 | 242.67 |
| CR22 / | 1 | | | | G | G | G | G | G | G | G | G | | | | | | | | | G | 5 | [6] 195.85 | 285.94 | 213.34 |
| | 2 | | | | G | | | | | | | | | | | | | | | | | 5 | [7] 199.38 | 263.17 | 212.35 |
| | 3 | | | | G | | | | | | | | | | | | | | | | | 5 | [8] 216.42 | 285.09 | 232.21 |
| | 4 | | | | G | | | | | | | | | | | | | | | | | 5 | [9] 200.20 | 264.85 | 215.35 |
| | 5 | | | | G | | | | | | | | | | | | | | | | | 5 | [10] 194.97 | 263.13 | 219.25 |
| SS1-SS-03-0-12 / | 1 | | | | N | N | N | G | | | | | | | | | | | | | G | 5 | [11] 184.30 | 255.31 | 196.09 |
| | 2 | | | | G | | | G | | | | | | | | | | | | | | 5 | [12] 197.80 | 290.32 | 218.85 |
| | 3 | | | | N | | | G | | | | | | | | | | | | | | 5 | [13] 206.63 | 294.32 | 224.55 |
| | 4 | | | | | | | G | | | | | | | | | | | | | | 5 | [14] 168.73 | 269.29 | 181.06 |
| | 5 | | | | | | | G | | | | | | | | | | | | | | 5 | [15] 187.87 | 265.58 | 205.15 |

| [illegible] | Rep | Number | Tare Weight (mg) | Dry Weight (mg) | Ashed Weight (mg) |
|---|---|---|---|---|---|
| [illegible] | 1 | 4 | [33] 51.03 | 52.88 | 51.96 |
| | 2 | 5 | [34] 51.00 | 52.54 | 51.38 |
| | 3 | 5 | [35] 51.01 | 52.58 | 51.54 |

① WC [illegible] 12/28

| CLIENT | PROJECT | JOB NO. | PROJECT MANAGER | LABORATORY / LOCATION | PROTOCOL | SPECIES |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | Port Gamble / | PSEP 1995 | [illegible] |

ENDPOINT DATA & OBSERVATIONS

| Sample | Rep | 1 (12/05 JL) | 2 (12/06 JL) | 3 (12/7) | 4 (12/8) | 5 (12/09 JL) | 6 (12/10) | 7 (12/11 JL) | 8 (12/12 JL) | 9 (12/13 JL) | 10 (12/14) | 11 (12/15) | 12 (12/16) | 13 (12/17 JL) | 14 (12/18) | 15 (12/19 JL) | 16 (12/20 JL) | 17 (12/21) | 18 (12/22) | 19 (12/23) | 20 (12/24 SW) | | | 261.00 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SS1-SS-05-0-12 ft | 1 | N | N | N | N | N | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | 5 | 16 184.26 | ~~260~~ ① | 194.53 |
| | 2 | | | | | | N | G | | | | | | | | | | | | | | 5 | 17 173.51 | 255.46 | 189.47 |
| | 3 | | | | | | | G | | | | | | | | | | | | | | 5 | 18 191.83 | 274.29 | 206.92 |
| | 4 | | | | | | G | G | | | | | | | | | | | | | | 5 | 19 204.14 | 294.75 | ① ~~227.46~~ 222.05 |
| | 5 | | | U | | | N | G | | | | | | | | | | | | | | 5 | 20 232.20 | 295.54 | 216.65 |
| SS1-SS-06-0-12 ft | 1 | | | N | | | N | G | | | | | | | | | | | | | G | 5 | 21 205.97 | 274.44 | 216.32 |
| | 2 | | | | | | | G | | | | | | | | | | | | | | 5 | 22 201.75 | 265.99 | 211.11 |
| | 3 | | | | | | | G | | | | | | | | | | | | | | 5 | 23 211.75 | 287.16 | 224.98 |
| | 4 | | | | G | | G | G | | | | | | | | | | | | | | 5 | 24 202.00 | 278.80 | 216.60 |
| | 5 | | | | N | | N | G | | | | | | | | | | | | | | 5 | 25 201.31 | 263.99 | 211.71 |

① MR HL 12/28

26 256.32
27 242.33
28 219.89

| CLIENT | PROJECT | START TIME/ END TIME | DILUTION WATER BATCH | PROTOCOL | TEST START DATE |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 1505 / | FSW120315.01 | PSEP 1995 | 4-Dec-2015 |
| **JOB NUMBER** | **PROJECT MANAGER** | **LABORATORY / LOCATION** | **ORGANISM BATCH** | **TEST SPECIES** | **TEST END DATE** |
| 0 | B. Hester | Port Gamble / Bath 5 | ATS110515 | Neanthes arenaceodentata | 24-Dec-2015 |

**WATER QUALITY DATA**

| TEST CONDITIONS | | | | DO (mg/L) > 4.6 | | TEMP (C) 20 ± 1 | | SALINITY (ppt) 28 ± 2 | | pH 8.0±1.0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID | DAY | REP | JAR | D.O. meter | mg/L | TEMP meter | °C | SALINITY meter | ppt | pH meter | unit | WATER RENEWAL | Feeding | TECH/DATE |
| Control / | 0 | Surr | 28 | 8 | 7.7 | 8 | 20.0 | 8 | 28 | 8 | 7.9 | | JL | JL 12/04 |
| Control / | 1 | Surr | | 8 | 7.1 | 8 | 20.2 | 8 | 28 | 8 | 7.6 ~~7.9~~ (1) | | | JL 12/05 |
| Control / | 2 | Surr | | 8 | 7.7 | 8 | 20.3 | 8 | 28 | 8 | 8.0 | | JL | JL 12/06 |
| Control / | 3 | Surr | | 8 | 7.2 | 8 | 20.1 | 8 | 29 | 8 | 7.8 | BH | | HE 12/7 |
| Control / | 4 | Surr | | 8 | (2) ~~6.9~~ 7.3 | 8 | 20.2 ~~20.2~~ | 8 | ~~28~~ 30 | 8 | ~~7.7~~ 7.8 | | HE | BE 12/8 |
| Control / | 5 | Surr | | 9 | 7.1 | 9 | 19.8 | 9 | 29 | 9 | 7.7 | | | JL 12/09 |
| Control / | 6 | Surr | | 9 | 6.8 | 9 | 19.8 | 9 | 29 | 9 | 7.8 | JL | HE | JL 12/10 |
| Control / | 7 | Surr | | 9 | 6.4 | 9 | 19.8 | 9 | 29 | 9 | 7.7 | | | JL 12/11 |
| Control / | 8 | Surr | | 9 | 7.3 | 9 | 19.8 | 9 | 30 | 9 | 8.0 | | JL | JL 12/12 |
| Control / | 9 | Surr | | 8 | 7.0 | 8 | 19.9 | 8 | 30 | 8 | 7.8 | JL | | JL 12/13 |
| Control / | 10 | Surr | | 8 | 7.4 | 8 | 19.9 | 8 | 30 | 8 | 8.0 | | HE | HE 12/14 |
| Control / | 11 | Surr | | 8 | 7.3 | 8 | 19.9 | 8 | 30 | 9 | 8.0 | | | HE 12/15 |
| Control / | 12 | Surr | | 8 | 7.5 | 8 | 19.9 | 8 | 30 | 8 | 8.0 | HE | HE | HE 12/16 |
| Control / | 13 | Surr | | 8 | 7.4 | 8 | 19.9 | 8 | 30 | 8 | 7.9 | | | JL 12/17 |
| Control / | 14 | Surr | | 8 | 7.3 | 8 | 20.0 | 8 | 31 | 8 | 8.0 | | HE | HE 12/18 |
| Control / | 15 | Surr | | 8 | 6.8 | 8 | 19.9 | 8 | 31 | 8 | 7.9 | JL | | JL 12/19 |
| Control / | 16 | Surr | | 8 | 7.5 | 8 | 20.0 | 8 | 30 | 8 | 8.2 | | JL | JL 12/20 |
| Control / | 17 | Surr | | 9 | 6.7 | 9 | 19.8 | 9 | 30 | 9 | 8.1 | | | HE 12/21 |
| Control / | 18 | Surr | | 9 | 7.0 | 9 | 19.7 | 9 | 30 | 9 | 8.0 | HE | BG | HE 12/22 |
| Control / | 19 | Surr | | 9 | 7.1 | 9 | 19.6 | 9 | 29 | 9 | 7.9 | | | HE 12/23 |
| Control / | 20 | Surr | | 9 | 7.0 | 9 | 19.7 | 9 | 30 | 9 | 8.0 | | | HE 12/24 |

(1) WP. JL 12/05/15. (2) wrong date 12.7.15 BH (3) wrong meter HE 12/21

| CLIENT | PROJECT | START TIME/ END TIME | DILUTION WATER BATCH | PROTOCOL | TEST START DATE |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 1505 / | FSW120315.01 | PSEP 1995 | 4-Dec-2015 |
| **JOB NUMBER** | **PROJECT MANAGER** | **LABORATORY / LOCATION** | **ORGANISM BATCH** | **TEST SPECIES** | **TEST END DATE** |
| 0 | B. Hester | Port Gamble / Bath 5 | ATS110515 | Neanthes arenaceodentata | 24-Dec-2015 |

**WATER QUALITY DATA**

| TEST CONDITIONS | | | | DO (mg/L) | | TEMP (C) | | SALINITY (ppt) | | pH | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | > 4.6 | | 20 ± 1 | | 28 ± 2 | | 8.0±1.0 | | | | |
| | | | | D.O. | | TEMP | | SALINITY | | pH | | WATER | | |
| SAMPLE ID | DAY | SIZE | [illegible] | meter | mg/L | meter | °C | meter | ppt | meter | unit | RENEWAL | Feeding | TECH/DATE |
| CR22 / | 0 | Surr | 7 | 8 | 7.5 | 8 | 19.6 | 8 | 28 | 8 | 7.9 | | JL | JL 12/04 |
| CR22 / | 1 | Surr | | 8 | 7.3 | 8 | 20.1 | 8 | 28 | 8 | 7.7 | | | JL 12/05 |
| CR22 / | 2 | Surr | | 8 | 7.6 | 8 | 20.2 | 8 | 28 | 8 | 8.1 | | JL | JL 12/06 |
| CR22 / | 3 | Surr | | 8 | 7.2 | 8 | 20.2 | 8 | 28 | 8 | 7.9 | OM | | [illegible] 12/7 |
| CR22 / | 4 | Surr | | 8 | 7.0 | 8 | 20.0 | 8 | 30 | 8 | 7.9 | | HE | BE 12/8 |
| CR22 / | 5 | Surr | | ① ~~8~~ 9 | 6.9 | ① ~~8~~ 9 | 20.0 | 9 | 29 | 9 | 7.9 | | | JL 12/09 |
| CR22 / | 6 | Surr | | 9 | 7.4 | 9 | 19.9 | 9 | 29 | 9 | 8.1 | JL | HE | JL 12/10 |
| CR22 / | 7 | Surr | | 9 | 7.5 | 9 | 19.8 | 9 | 29 | 9 | 8.1 | | | JL 12/11 |
| CR22 / | 8 | Surr | | 9 | 7.7 | 9 | 19.8 | 9 | 29 | 9 | 8.5 | | JL | JL 12/12 |
| CR22 / | 9 | Surr | | 8 | 7.8 | 8 | 20.1 | 8 | 30 | 8 | 8.4 | JL | | JL 12/13 |
| CR22 / | 10 | Surr | | 8 | 8.1 | 8 | 19.7 | 8 | 30 | 8 | 8.3 | | HE | HE 12/14 |
| CR22 / | 11 | Surr | | 8 | ② ~~8.2~~ 7.7 | 8 | 19.9 | 8 | 30 | 8 | 8.2 | | | HE 12/15 |
| CR22 / | 12 | Surr | | 8 | 7.6 | 8 | 20.0 | 8 | 30 | 8 | 8.2 | HE | HE | HE 12/16 |
| CR22 / | 13 | Surr | | 8 | 7.6 | 8 | 19.9 | 8 | 30 | 8 | 8.2 | | | JL 12/17 |
| CR22 / | 14 | Surr | | 8 | 7.3 | 8 | 20.1 | 8 | 30 | 8 | 8.2 | | HE | HE 12/18 |
| CR22 / | 15 | Surr | | 8 | 7.4 | 8 | 20.0 | 8 | 31 | 8 | 8.2 | JL | | JL 12/19 |
| CR22 / | 16 | Surr | | 8 | 7.7 | 8 | 20.1 | 8 | 30 | 8 | 8.3 | | JL | JL 12/20 |
| CR22 / | 17 | Surr | | 9 | 7.1 | 9 | 19.8 | 9 | 30 | 9 | 8.6 | | | HE 12/21 |
| CR22 / | 18 | Surr | | 9 | 7.4 | 9 | 19.6 | 9 | 30 | 9 | 8.1 | HE | BE | HE 12/22 |
| CR22 / | 19 | Surr | | 9 | 7.4 | 9 | 19.7 | 9 | 29 | 9 | 8.1 | | | HE 12/23 |
| CR22 / | 20 | Surr | | 9 | ③ ~~7.0~~ 7.3 | 9 | 19.7 | 9 | 30 | 9 | ③ ~~8.0~~ 8.2 | | | HE 12/24 |

① wrong meter JL 12/09/15 ② WC HE 12/15 ③ WP HE 12/24

| CLIENT | PROJECT | START TIME/ END TIME | DILUTION WATER BATCH | PROTOCOL | TEST START DATE |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 1505 / | FSW120315.01 | PSEP 1995 | 4-Dec-2015 |
| **JOB NUMBER** | **PROJECT MANAGER** | **LABORATORY / LOCATION** | **ORGANISM BATCH** | **TEST SPECIES** | **TEST END DATE** |
| 0 | S. Hester | Port Gamble / Bath 5 | ATS110515 | [illegible] | 24-Dec-2015 |

**WATER QUALITY DATA**

| TEST CONDITIONS | | | | DO (mg/L) > 4.6 | | TEMP (C) 20 ± 1 | | SALINITY (ppt) 28 ± 2 | | pH 8.0±1.0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID | DAY | REP | CHB | D.O. meter | mg/L | TEMP meter | °C | SALINITY meter | ppt | pH meter | unit | WATER RENEWAL | Feeding | TECH/DATE |
| SS1-SS-03-0-12 / | 0 | Surr | 21 | 8 | 7.6 | 8 | 19.5 | 8 | 28 | 8 | 7.9 | | JL | JL 12/04 |
| SS1-SS-03-0-12 / | 1 | Surr | | 8 | 7.5 | 8 | 20.1 | 8 | 28 | 8 | 7.9 | | | JL 12/05 |
| SS1-SS-03-0-12 / | 2 | Surr | | 8 | 7.6 | 8 | 20.1 | 8 | 27 | 8 | 8.2 | | JL | JL 12/06 |
| SS1-SS-03-0-12 / | 3 | Surr | | 8 | 7.2 | 8 | 20.2 | 8 | 29 | 8 | 8.1 | CH | | [illegible] 12/7 |
| SS1-SS-03-0-12 / | 4 | Surr | | 8 | 7.2 | 8 | 20.0 | 8 | 29 | 8 | 8.1 | | [illegible] | BE 12/8 |
| SS1-SS-03-0-12 / | 5 | Surr | | 9 | 7.1 | 9 | 19.8 | 9 | 29 | 9 | 8.2 | | | JL 12/09 |
| SS1-SS-03-0-12 / | 6 | Surr | | 9 | 6.9 | 9 | 19.8 | 9 | 30 | 9 | 8.3 | JL | HE | JL 12/10 |
| SS1-SS-03-0-12 / | 7 | Surr | | 9 | 7.1 | 9 | 19.6 | 9 | 30 | 9 | 8.2 | | | JL 12/11 |
| SS1-SS-03-0-12 / | 8 | Surr | | 9 | 7.3 | 9 | 19.6 | 9 | 30 | 9 | 8.4 | | JL | JL 12/12 |
| SS1-SS-03-0-12 / | 9 | Surr | | 8 | 7.4 | 8 | 19.9 | 8 | 31 | 8 | 8.4 | JL | | JL 12/13 |
| SS1-SS-03-0-12 / | 10 | Surr | | 8 | 7.6 | 8 | 19.7 | 8 | 31 ~~30~~ ① | 8 | 8.4 | | HE | [illegible] 12/14 |
| SS1-SS-03-0-12 / | 11 | Surr | | 8 | 7.7 | 8 ④ | ~~19.9~~ MR | 8 | 31 ~~30~~ ② | 8 | 8.4 | | | HE 12/15 |
| SS1-SS-03-0-12 / | 12 | Surr | | 8 | 7.6 | 8 | 19.8 | 8 | 32 | 8 | 8.4 | HE | HE | HE 12/16 |
| SS1-SS-03-0-12 / | 13 | Surr | | 8 | 7.5 | 8 | 19.8 | 8 | 31 | 8 | 8.3 | | | JL 12/~~18~~17 ③ |
| SS1-SS-03-0-12 / | 14 | Surr | | 8 | 7.3 | 8 | 20.0 | 8 | 31 | 8 | 8.3 | | [illegible] | HE 12/18 |
| SS1-SS-03-0-12 / | 15 | Surr | | 8 | 7.4 | 8 | 20.0 | 8 | 31 | 8 | 8.3 | JL | | JL 12/19 |
| SS1-SS-03-0-12 / | 16 | Surr | | 8 | 7.6 | 8 | 19.9 | 8 | 30 ~~29~~ ④ | 8 | 8.4 | | JL | JL 12/20 |
| SS1-SS-03-0-12 / | 17 | Surr | | 9 | 6.8 | 9 | 19.7 | 9 | 30 | 9 | 8.6 | | | [illegible] 12/21 |
| SS1-SS-03-0-12 / | 18 | Surr | | 9 | 7.0 | 9 | 19.6 | 9 | 31 | 9 | 8.4 | HE | BZ | HE 12/22 |
| SS1-SS-03-0-12 / | 19 | Surr | | 9 | 7.0 | 9 | 19.6 | 9 | 30 | 9 | 8.2 | | | [illegible] 12/23 |
| SS1-SS-03-0-12 / | 20 | Surr | | 9 | 7.0 | 9 | 19.6 | 9 | 30 | 9 | 8.3 | | | [illegible] 12/24 |

① [illegible] 12/14 ② WD HE 12/15 ③ WD. JL 12/17/15. ④ MR. JL 12/24/15.

ENVIRON

| CLIENT | PROJECT | START TIME/ END TIME | DILUTION WATER BATCH | PROTOCOL | TEST START DATE |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 1505 / | FSW120315.01 | PSEP 1995 | 4-Dec-2015 |
| **JOB NUMBER** | **PROJECT MANAGER** | **LABORATORY / LOCATION** | **ORGANISM BATCH** | **TEST SPECIES** | **TEST END DATE** |
| 0 | B. Hester | Port Gamble / Bath 5 | ATS110515 | Neanthes arenaceodentata | 24-Dec-2015 |

**WATER QUALITY DATA**

| TEST CONDITIONS | | | | DO (mg/L) > 4.6 | | TEMP (C) 20 ± 1 | | SALINITY (ppt) 28 ± 2 | | pH 8.0±1.0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID | DAY | REP | JAR | D.O. meter | mg/L | TEMP meter | °C | SALINITY meter | ppt | pH meter | unit | WATER RENEWAL | Feeding | TECH/DATE |
| SS1-SS-05-0-12 / | 0 | Surr | 14 | 8 | 7.6 | 8 | 20.0 | 8 | 28 | 8 | 8.0 | | JL | JL 12/04 |
| SS1-SS-05-0-12 / | 1 | Surr | | 8 | 7.4 | 8 | 20.2 | 8 | 28 | 8 | 7.8 | | | JL 12/05 |
| SS1-SS-05-0-12 / | 2 | Surr | | 8 | 7.5 | 8 | 20.2 | 8 | 28 | 8 | 8.2 | | JL | JL 12/06 |
| SS1-SS-05-0-12 / | 3 | Surr | | 8 | 7.2 | 8 | 20.2 | 8 | 29 | 8 | 8.2 | BH | | HE 12/07 |
| SS1-SS-05-0-12 / | 4 | Surr | | 8 | 7.1 | 8 | 20.2 | 8 | 29 | 8 | 8.2 | | HE | BE 12/8 |
| SS1-SS-05-0-12 / | 5 | Surr | | 9 | 6.9 | 9 | 19.9 | 9 | 29 | 9 | 8.1 | | | JL 12/09 |
| SS1-SS-05-0-12 / | 6 | Surr | | 9 | 7.1 | 9 | 19.8 | 9 | 30 | 9 | 8.3 | JL | HE | JL 12/10 |
| SS1-SS-05-0-12 / | 7 | Surr | | 9 | 7.2 | 9 | 19.7 | 9 | 30 | 9 | 8.3 | | | JL 12/11 |
| SS1-SS-05-0-12 / | 8 | Surr | | 9 | 7.5 | 9 | 19.7 | 9 | 30 | 9 | 8.6 | | JL | JL 12/12 |
| SS1-SS-05-0-12 / | 9 | Surr | | 8 | 7.6 | 8 | 20.0 | 8 | 30 | 8 | 8.6 | JL | | JL 12/13 |
| SS1-SS-05-0-12 / | 10 | Surr | | 8 | 7.9 | 8 | 19.9 | 8 | 31 | 8 | 8.5 | | HE | HE 12/14 |
| SS1-SS-05-0-12 / | 11 | Surr | | 8 | 7.6 | 8 | 19.8 | 8 | 31 | 8 | 8.4 | | | HE 12/15 |
| SS1-SS-05-0-12 / | 12 | Surr | | 8 | 7.6 | 8 | 19.9 | 8 | 31 | 8 | 8.4 | HE | HE | HE 12/16 |
| SS1-SS-05-0-12 / | 13 | Surr | | 8 | 7.4 | 8 | 19.8 | 8 | 31 | 8 | 8.3 | | | JL 12/17 |
| SS1-SS-05-0-12 / | 14 | Surr | | 8 | 7.3 | 8 | 20.0 | 8 | 31 | 8 | 8.4 | | HE | HE 12/18 |
| SS1-SS-05-0-12 / | 15 | Surr | | 8 | 7.5 | 8 | 20.0 | 8 | 31 | 8 | 8.5 | JL | | JL 12/19 |
| SS1-SS-05-0-12 / | 16 | Surr | | 8 | 8.0 | 8 | 20.0 | 8 | 30 | 8 | 8.6 | | JL | JL 12/20 |
| SS1-SS-05-0-12 / | 17 | Surr | | 9 | 7.4 | 9 | 19.8 | 9 | 30 | 9 | 8.7 | | | HE 12/21 |
| SS1-SS-05-0-12 / | 18 | Surr | | 9 | 7.4 | 9 | 19.7 | 9 | 30 | 9 | 8.5 | HE | BE | HE 12/22 |
| SS1-SS-05-0-12 / | 19 | Surr | | 9 | 7.5 | 9 | 19.7 | 9 | 30 | 9 | 8.4 | | | HE 12/23 |
| SS1-SS-05-0-12 / | 20 | Surr | | 9 | 2 ~~7.5~~ 7.3 1 | 9 | 19.6 | 9 | 30 | 9 | 2 ~~8.2~~ 1 8.4 | | | HE 12/24 |

1 SM HE 12/24 2 WP HE 12/24

| CLIENT | PROJECT | START TIME/ END TIME | DILUTION WATER BATCH | PROTOCOL | TEST START DATE |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 1505 / | FSW120315.01 | PSEP 1995 | 4-Dec-2015 |
| **JOB NUMBER** | **PROJECT MANAGER** | **LABORATORY / LOCATION** | **ORGANISM BATCH** | **TEST SPECIES** | **TEST END DATE** |
| 0 | B. Hester | Port Gamble / Bath 5 | ATS110515 | Neanthes arenaceodentata | 24-Dec-2015 |

**WATER QUALITY DATA**

| TEST CONDITIONS | | | | DO (mg/L) | | TEMP (C) | | SALINITY (ppt) | | pH | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | > 4.6 | | 20 ± 1 | | 28 ± 2 | | 8.0±1.0 | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | D.O. | | TEMP | | SALINITY | | pH | | WATER RENEWAL | Feeding | TECH/DATE |
| | | | | meter | mg/L | meter | °C | meter | ppt | meter | unit | | | |
| SS1-SS-06-0-12 / | 0 | Surr | 19 | 8 | 7.6 | 8 | 20.0 | 8 | 28 | 8 | 8.1 | | JL | JL 12/04 |
| SS1-SS-06-0-12 / | 1 | Surr | | 8 | 7.1 | 8 | 20.2 | 8 | 28 | 8 | 7.7 | | | JL 12/05 |
| SS1-SS-06-0-12 / | 2 | Surr | | 8 | 6.8 | 8 | 20.2 | 8 | 28 | 8 | 8.0 | | JL | JL 12/06 |
| SS1-SS-06-0-12 / | 3 | Surr | | 8 | 7.3 | 8 | 20.2 | 8 | 29 | 8 | 8.1 | [illegible] | | HE 12/7 |
| SS1-SS-06-0-12 / | 4 | Surr | | 8 | 7.1 | 8 | 20.2 | 8 | 29 | 8 | 8.2 | | HE | BE 12/8 |
| SS1-SS-06-0-12 / | 5 | Surr | | 9 | 6.6 | 9 | 20.0 | 9 | 29 | 9 | 8.1 | | | JL 12/09 |
| SS1-SS-06-0-12 / | 6 | Surr | | 9 | 6.9 | 9 | 19.9 | 9 | 30 | 9 | 8.4 | JL | HE | JL 12/10 |
| SS1-SS-06-0-12 / | 7 | Surr | | 9 | 7.0 | 9 | 19.7 | 9 | 30 | 9 | 8.3 | | | JL 12/11 |
| SS1-SS-06-0-12 / | 8 | Surr | | 9 | 7.4 | 9 | 19.7 | 9 | 30 | 9 | 8.6 | | JL | JL 12/12 |
| SS1-SS-06-0-12 / | 9 | Surr | | 8 | 7.6 | 8 | 20.0 | 8 | 30 | 8 | 8.5 | JL | | JL 12/13 |
| SS1-SS-06-0-12 / | 10 | Surr | | 8 | 7.8 | 8 | 19.7 | 8 | 30 | 8 | 8.5 | | HE | HE 12/14 |
| SS1-SS-06-0-12 / | 11 | Surr | | 8 | 7.7 | 8 | 19.9 | 8 | 30 | 8 | 8.4 | | | HE 12/15 |
| SS1-SS-06-0-12 / | 12 | Surr | | 8 | 7.6 | 8 | 19.9 | 8 | 31 | 8 | 8.4 | HE | HE | HE 12/16 |
| SS1-SS-06-0-12 / | 13 | Surr | | 8 | 7.4 | 8 | 19.8 | 8 | 31 | 8 | 8.3 | | | JL 12/17 |
| SS1-SS-06-0-12 / | 14 | Surr | | 8 | 7.3 | 8 | 20.0 | 8 | 31 | 8 | 9.3 | | HE | HE 12/18 |
| SS1-SS-06-0-12 / | 15 | Surr | | 8 | 7.0 | 8 | 20.0 | 8 | 31 | 8 | 8.2 | JL | | JL 12/19 |
| SS1-SS-06-0-12 / | 16 | Surr | | 8 | 7.6 | 8 | 20.0 | 8 | 30 | 8 | 8.4 | | JL | JL 12/20 |
| SS1-SS-06-0-12 / | 17 | Surr | | 9 | 6.7 | 9 | 19.8 | 9 | 30 | 9 | 8.5 | | | HE 12/21 |
| SS1-SS-06-0-12 / | 18 | Surr | | 9 | 7.0 | 9 | 19.7 | 9 | 30 | 9 | 8.2 | HE | BE | HE 12/22 |
| SS1-SS-06-0-12 / | 19 | Surr | | 9 | 7.0 | 9 | 19.7 | 9 | 29 | 9 | 8.1 | | | HE 12/23 |
| SS1-SS-06-0-12 / | 20 | Surr | | 9 | 6.3 | 9 | 19.6 | 9 | 30 | 9 | 7.9 | | | HE 12/24 |

RAMBOLL ENVIRON **Ammonia and Sulfide Analysis Record**



| Client/Project: GeoEngineers / PG Haley | Organism: Neanthes arenaceodentata | Test Duration (days): 20 |
|---|---|---|

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: Ø

OVERLYING (OV) → POREWATER (PW) (circle one) / Comments:

| Calibration Standards Temperature | | |
|---|---|---|
| Date: 12/04/15 | Temperature: 19.0°C | Sample temperature should be within ±1°C of standards temperature at time and date of analysis. |

| Sample ID or Description | Conc. or Rep | Date of Sampling and Initials | Ammonia Value (mg/L) | Temp °C | Date of Reading and Initials | Sample Preserved (Y/N) | pH | Sal (ppt) | Sample Volume (mL) | Measured Sulf. (mg/L) | Multi-plier | Calc-ulated Sulf. (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OV Control | Surr. | 12/04/15 JL | 0.126 | 19.0 | 12/04/15 JL | N | | | 10 | 0.00 | NA | NA |
| CR-22 | | | 0.00 | | | | | | | 0.006 | | |
| 3 | | | 0.00 | | | | | | | 0.015 | | |
| 5 | | | 1.82 | | | | | | | 0.007 | | |
| 6 | | | 1.84 | | | | | | | 0.002 | | |
| | | | | | | | | | | | | |
| PW Control | | | 0.638 | 19.6 | | | 7.5 | 27 | 2 | 0.040 | 5 | 0.20 |
| CR-22 | | | 1.37 | | | | 7.7 | 29 | | 0.011 | | 0.055 |
| 3 | | | 8.13 | | | | 7.8 | 30 | | 0.00 | | 0.00 |
| 5 | | | 9.64 | | | | 7.9 | 29 | | 0.034 | | 0.17 |
| 6 | | | 12.3 | | | | 8.0 | 29 | | 0.031 | | 0.155 |

# Ammonia and Sulfide Analysis Record

RAMBOLL ENVIRON



| Client/Project: | Organism: | Test Duration (days): |
|---|---|---|
| GeoEngineers RG Haley | Neanthes | 20 |

PRETEST / INITIAL / FINAL / OTHER (circle one)

DAY of TEST: 20

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: ___

| Calibration Standards Temperature | | Sample temperature should be within ±1°C of standards temperature at time and date of analysis. |
|---|---|---|
| Date: | Temperature: | |
| 12/24/15 | 17.5 | |

| Sample ID or Description | Conc. or Rep | Date of Sampling and Initials | Ammonia Value (mg/L) | Temp °C | Date of Reading and Initials | Sample Preserved (Y/N) | pH | Sal (ppt) | Sample Volume (mL) | Measured Sulf. (mg/L) | Multi-plier | Calc-ulated Sulf. (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OV & | Surf | HZ 12/24 | 3.98 | 17.5 | 12/24 HZ | N | | | 10 | 0.018 | | |
| CR-22 | | | 0.00 | | | | | | | 0.069 | | |
| 3 | | | 0.00 | | | | | | | 0.020 | | |
| 5 | | | 0.00 | | | | | | | 0.063 | | |
| 6 | | | 0.00 | | | | | | | 0.015 | | |
| PW & | Surf | HZ 12/24 | 5.77 | 16.5 | 12/24 HZ | N | 7.6 | 29 | 2 | 0.017 | 5 | 0.085 |
| CR-22 | | | 0.760 | | | | 7.1 | 29 | | 0.061 | | 0.305 |
| 3 | | | 0.00 | | | | 7.3 | 30 | | 0.023 | | 0.115 |
| 5 | | | 0.00 | | | | 7.0 | 30 | | 0.023 | | 0.115 |
| 6 | | | 1.11 | | | | 6.6 | 29 | | 0.045 | | 0.225 |

# ORGANISM RECEIPT LOG

**Date:** 12/04/15

**Time:** 1420

**Batch No.** ATS120415

**Organism / Project:** Neanthes / RG Haley

**Source / Supplier:** Aquatic Tox. Support

**No. Ordered:** 360

**No. Received:** 396

**Source Batch:** Collection date, hatch date, etc.): Emerged Nov. 13-18

**Condition of Organisms:** Good

**Approximate Size or Age:** (Days from hatch, life stage, size class, etc.): 21- 26 days

**Shipper:** Courier

**B of L (Tracking No.)** NA

**Condition of Container:** Good

**Received By:** JL

| Container | D.O. (mg/L) | Temp. (°C) | Cond. or Sal. (Include Units) | pH (Units) | # Dead | % Dead* | Tech. (Initials) |
|---|---|---|---|---|---|---|---|
| 1 | 11.5 | 18.5 | 29ppt | 7.5 | — | — | JL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

*if >10% contact lab manager

**Notes:** NA

Aquatic Toxicology Support
1849 Charleston Beach Road West
Bremerton, Washington 98312
(360) 813-1202

Order Summary

| | |
|---|---|
| Species: *Neanthes arenaceodentata** | Emerge Date: 13-18 Nov '15 |
| Number Ordered: 360 | Number Shipped: 360+10% |
| Date Shipped: 4 Dec '15 | Salinity (ppt): 30 |

*Smith 1964. CSU Long Beach strain. Feed upon arrival.

# APPENDIX A.2.2

## *Neanthes arenaceodentata*

## Juvenile Polychaete Bioassay

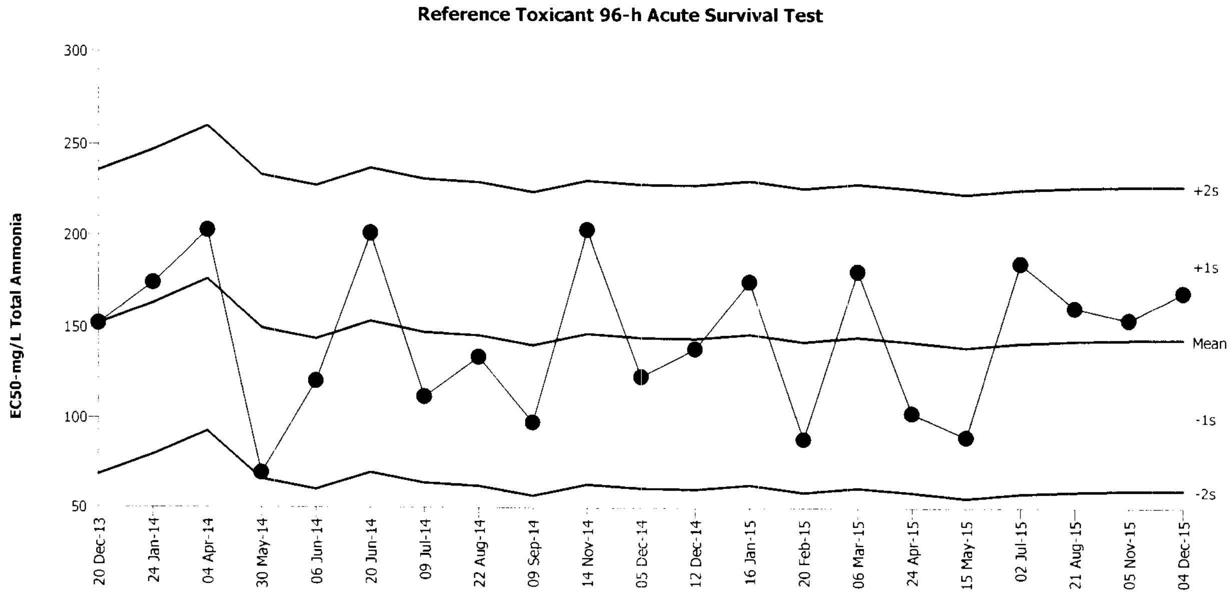
## Reference Toxicant Test

## CETIS QC Plot

**Report Date:** 09 Dec-15 14:23 ( 1 of 1)

**Reference Toxicant 96-h Acute Survival Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Neanthes arenaceodentata (Polycha | **Material:** | Total Ammonia |
| **Protocol:** | PSEP (1995) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 143.4 | **Count:** | 20 | **-1s Warning Limit:** | 101.6 | **-2s Action Limit:** | 59.76 |
| **Sigma:** | 41.83 | **CV:** | 29.20% | **+1s Warning Limit:** | 185.3 | **+2s Action Limit:** | 227.1 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2013 | Dec | 20 | 14:00 | 152.2 | 8.771 | 0.2097 | | | 08-9922-1254 | 05-5343-6267 | NewFields |
| 2 | 2014 | Jan | 24 | 13:20 | 174.5 | 31.12 | 0.7441 | | | 20-9603-7883 | 05-6245-5381 | NewFields |
| 3 | | Apr | 4 | 15:40 | 202.9 | 59.48 | 1.422 | (+) | | 09-1443-8374 | 04-8864-2138 | ENVIRON |
| 4 | | May | 30 | 16:25 | 69.43 | -73.97 | -1.768 | (-) | | 18-4751-2702 | 06-4812-5268 | ENVIRON |
| 5 | | Jun | 6 | 14:00 | 120.6 | -22.83 | -0.5457 | | | 02-4901-6395 | 02-6665-3375 | ENVIRON |
| 6 | | | 20 | 13:20 | 201.3 | 57.95 | 1.385 | (+) | | 04-8899-1061 | 18-6388-8462 | ENVIRON |
| 7 | | Jul | 9 | 15:30 | 112 | -31.38 | -0.7501 | | | 00-3047-6484 | 19-8550-4064 | ENVIRON |
| 8 | | Aug | 22 | 12:30 | 133.9 | -9.533 | -0.2279 | | | 19-3698-7324 | 19-8424-2994 | ENVIRON |
| 9 | | Sep | 9 | 15:00 | 97.87 | -45.53 | -1.089 | (-) | | 04-0379-7898 | 08-6657-8417 | ENVIRON |
| 10 | | Nov | 14 | 11:11 | 203.3 | 59.88 | 1.431 | (+) | | 09-0815-7159 | 21-3147-5839 | ENVIRON |
| 11 | | Dec | 5 | 11:50 | 123.1 | -20.31 | -0.4855 | | | 14-5288-4655 | 12-0797-2995 | ENVIRON |
| 12 | | | 12 | 11:45 | 138.4 | -4.956 | -0.1185 | | | 04-7774-5498 | 11-0912-6539 | ENVIRON |
| 13 | 2015 | Jan | 16 | 11:15 | 175.3 | 31.89 | 0.7623 | | | 03-9642-9379 | 19-1724-7286 | ENVIRON |
| 14 | | Feb | 20 | 14:50 | 88.65 | -54.75 | -1.309 | (-) | | 12-3560-9864 | 07-2965-5219 | ENVIRON |
| 15 | | Mar | 6 | 11:50 | 181.2 | 37.76 | 0.9026 | | | 09-2159-7453 | 09-1672-5355 | ENVIRON |
| 16 | | Apr | 24 | 12:50 | 103.1 | -40.32 | -0.9639 | | | 01-6315-9057 | 02-6990-5019 | ENVIRON |
| 17 | | May | 15 | 14:00 | 89.83 | -53.57 | -1.281 | (-) | | 15-1184-2734 | 08-8902-1629 | ENVIRON |
| 18 | | Jul | 2 | 14:15 | 185.6 | 42.18 | 1.008 | (+) | | 18-8075-0902 | 16-6019-0259 | ENVIRON |
| 19 | | Aug | 21 | 16:33 | 161 | 17.58 | 0.4204 | | | 18-5704-8732 | 08-2852-0434 | ENVIRON |
| 20 | | Nov | 5 | 16:00 | 154.3 | 10.94 | 0.2614 | | | 15-0871-2744 | 12-3779-6972 | ENVIRON |
| 21 | | Dec | 4 | 15:55 | 169.2 | 25.82 | 0.6173 | | | 15-8650-5167 | 03-4063-5051 | ENVIRON |



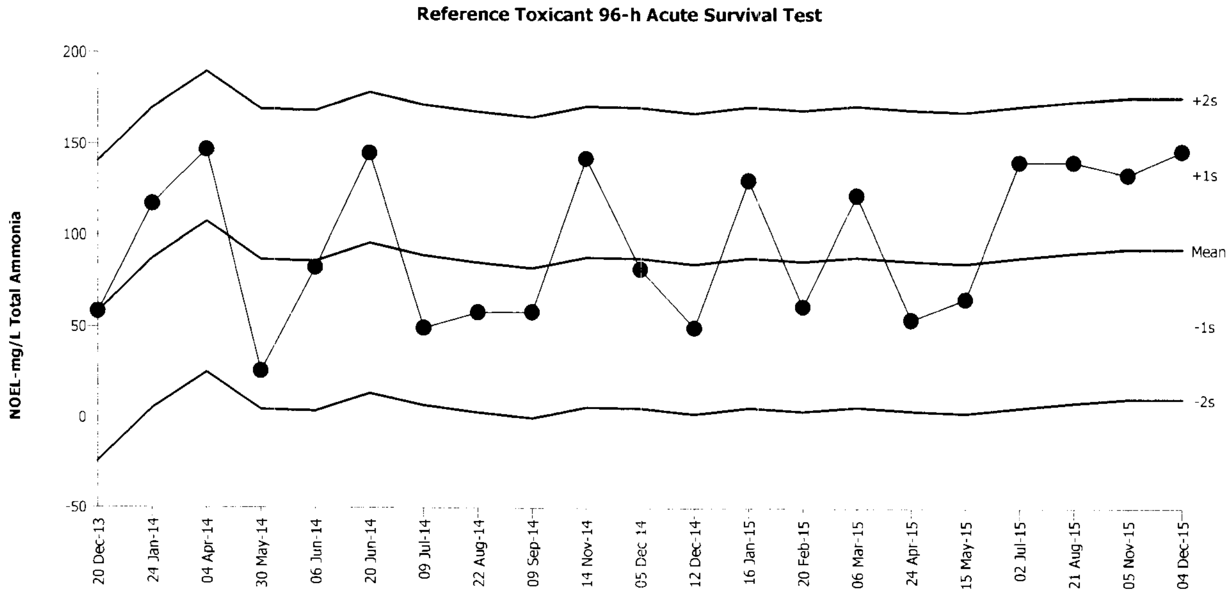
Analyst: JL QA:________

# CETIS QC Plot

**Report Date:** 09 Dec-15 14:23 ( 1 of 1)

**Reference Toxicant 96-h Acute Survival Test** **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Neanthes arenaceodentata (Polycha | **Material:** | Total Ammonia |
| **Protocol:** | PSEP (1995) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 93.07 | **Count:** | 20 | **-1s Warning Limit:** | 51.89 | **-2s Action Limit:** | 10.71 |
| **Sigma:** | 41.18 | **CV:** | 44.20% | **+1s Warning Limit:** | 134.3 | **+2s Action Limit:** | 175.4 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2013 | Dec | 20 | 14:00 | 58.3 | -34.77 | -0.8443 | | | 08-9922-1254 | 11-2068-6689 | NewFields |
| 2 | 2014 | Jan | 24 | 13:20 | 117 | 23.93 | 0.5811 | | | 20-9603-7883 | 15-6685-9407 | NewFields |
| 3 | | Apr | 4 | 15:40 | 147 | 53.93 | 1.31 | (+) | | 09-1443-8374 | 10-8829-6450 | ENVIRON |
| 4 | | May | 30 | 16:25 | 25.7 | -67.37 | -1.636 | (-) | | 18-4751-2702 | 12-3702-5556 | ENVIRON |
| 5 | | Jun | 6 | 14:00 | 82.6 | -10.47 | -0.2542 | | | 02-4901-6395 | 20-5404-5146 | ENVIRON |
| 6 | | | 20 | 13:20 | 145 | 51.93 | 1.261 | (+) | | 04-8899-1061 | 10-6019-5810 | ENVIRON |
| 7 | | Jul | 9 | 15:30 | 49.5 | -43.57 | -1.058 | (-) | | 00-3047-6484 | 08-3152-1432 | ENVIRON |
| 8 | | Aug | 22 | 12:30 | 58.1 | -34.97 | -0.8492 | | | 19-3698-7324 | 16-9806-3196 | ENVIRON |
| 9 | | Sep | 9 | 15:00 | 58.3 | -34.77 | -0.8443 | | | 04-0379-7898 | 19-3535-3112 | ENVIRON |
| 10 | | Nov | 14 | 11:11 | 142 | 48.93 | 1.188 | (+) | | 09-0815-7159 | 10-8173-5203 | ENVIRON |
| 11 | | Dec | 5 | 11:50 | 81.9 | -11.17 | -0.2712 | | | 14-5288-4655 | 20-6606-9579 | ENVIRON |
| 12 | | | 12 | 11:45 | 49.7 | -43.37 | -1.053 | (-) | | 04-7774-5498 | 10-4327-6265 | ENVIRON |
| 13 | 2015 | Jan | 16 | 11:15 | 130 | 36.93 | 0.8968 | | | 03-9642-9379 | 02-7191-1789 | ENVIRON |
| 14 | | Feb | 20 | 14:50 | 61.4 | -31.67 | -0.7691 | | | 12-3560-9864 | 14-9510-1611 | ENVIRON |
| 15 | | Mar | 6 | 11:50 | 122 | 28.93 | 0.7025 | | | 09-2159-7453 | 06-6960-4147 | ENVIRON |
| 16 | | Apr | 24 | 12:50 | 54.3 | -38.77 | -0.9415 | | | 01-6315-9057 | 00-4642-5370 | ENVIRON |
| 17 | | May | 15 | 14:00 | 65.6 | -27.47 | -0.6671 | | | 15-1184-2734 | 09-3943-6020 | ENVIRON |
| 18 | | Jul | 2 | 14:15 | 140 | 46.93 | 1.14 | (+) | | 18-8075-0902 | 00-0324-0641 | ENVIRON |
| 19 | | Aug | 21 | 16:33 | 140 | 46.93 | 1.14 | (+) | | 18-5704-8732 | 12-5806-5521 | ENVIRON |
| 20 | | Nov | 5 | 16:00 | 133 | 39.93 | 0.9696 | | | 15-0871-2744 | 05-8415-3689 | ENVIRON |
| 21 | | Dec | 4 | 15:55 | 146 | 52.93 | 1.285 | (+) | | 15-8650-5167 | 03-6544-2607 | ENVIRON |



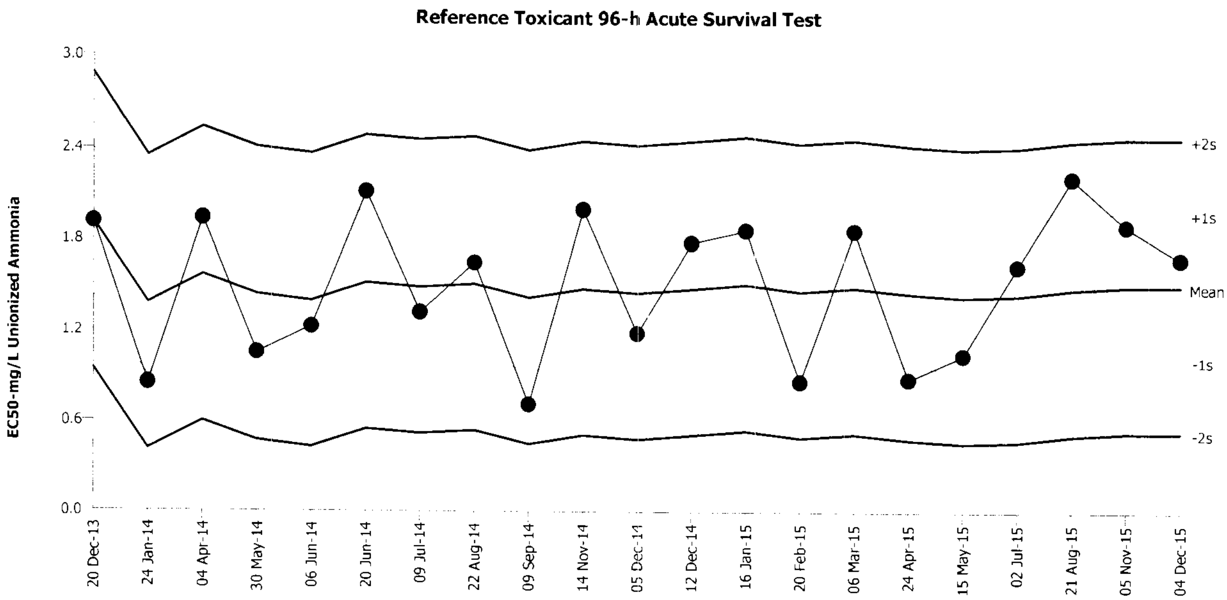
Analyst: JL QA:

# CETIS QC Plot

**Report Date:** 09 Dec-15 14:30 ( 1 of 1)

**Reference Toxicant 96-h Acute Survival Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Neanthes arenaceodentata (Polycha | **Material:** | Unionized Ammonia |
| **Protocol:** | PSEP (1995) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 1.5 | **Count:** | 20 | **-1s Warning Limit:** | 1.016 | **-2s Action Limit:** | 0.5312 |
| **Sigma:** | 0.4845 | **CV:** | 32.30% | **+1s Warning Limit:** | 1.985 | **+2s Action Limit:** | 2.469 |

**Quality Control Data**

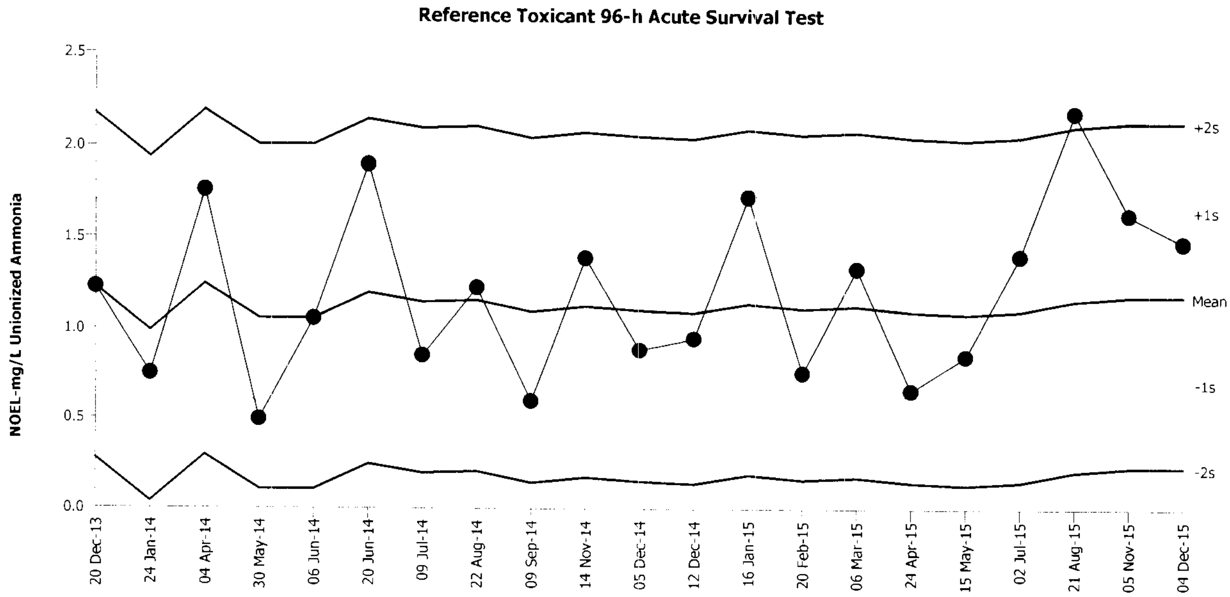
| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2013 | Dec | 20 | 14:00 | 1.916 | 0.4156 | 0.8578 | | | 01-5055-0133 | 16-3961-8899 | NewFields |
| 2 | 2014 | Jan | 24 | 13:20 | 0.8517 | -0.6483 | -1.338 | (-) | | 09-1104-1497 | 12-8333-6553 | NewFields |
| 3 | | Apr | 4 | 15:40 | 1.94 | 0.4397 | 0.9076 | | | 00-6512-2526 | 06-9520-2408 | NewFields |
| 4 | | May | 30 | 16:25 | 1.055 | -0.4452 | -0.9189 | | | 04-6747-6619 | 11-2879-2220 | ENVIRON |
| 5 | | Jun | 6 | 14:00 | 1.228 | -0.2724 | -0.5623 | | | 19-7971-8908 | 15-6482-0033 | ENVIRON |
| 6 | | | 20 | 13:20 | 2.113 | 0.6135 | 1.266 | (+) | | 01-9511-3585 | 14-0146-3778 | ENVIRON |
| 7 | | Jul | 9 | 15:30 | 1.322 | -0.1777 | -0.3668 | | | 09-1500-8488 | 10-4546-7656 | ENVIRON |
| 8 | | Aug | 22 | 12:30 | 1.65 | 0.1498 | 0.3092 | | | 18-5611-8800 | 16-9514-3424 | ENVIRON |
| 9 | | Sep | 9 | 15:00 | 0.7125 | -0.7875 | -1.625 | (-) | | 18-5349-8839 | 17-4717-4294 | ENVIRON |
| 10 | | Nov | 14 | 11:11 | 1.998 | 0.4984 | 1.029 | (+) | | 17-3054-3443 | 08-9007-7058 | ENVIRON |
| 11 | | Dec | 5 | 11:50 | 1.187 | -0.3134 | -0.6468 | | | 14-0275-5265 | 10-7706-7479 | ENVIRON |
| 12 | | | 12 | 11:45 | 1.782 | 0.2824 | 0.583 | | | 04-5967-6225 | 06-1786-3304 | ENVIRON |
| 13 | 2015 | Jan | 16 | 11:15 | 1.864 | 0.364 | 0.7513 | | | 18-9719-6747 | 15-5803-7088 | ENVIRON |
| 14 | | Feb | 20 | 14:50 | 0.866 | -0.634 | -1.309 | (-) | | 15-6687-7653 | 15-3894-5718 | ENVIRON |
| 15 | | Mar | 6 | 11:50 | 1.861 | 0.3613 | 0.7457 | | | 11-3697-1780 | 11-9165-3524 | ENVIRON |
| 16 | | Apr | 24 | 12:50 | 0.8832 | -0.6168 | -1.273 | (-) | | 01-0867-6874 | 09-2102-1717 | ENVIRON |
| 17 | | May | 15 | 14:00 | 1.043 | -0.4573 | -0.9439 | | | 09-1275-9559 | 04-5482-9783 | ENVIRON |
| 18 | | Jul | 2 | 14:15 | 1.633 | 0.1325 | 0.2736 | | | 12-0891-3679 | 07-1814-7730 | ENVIRON |
| 19 | | Aug | 21 | 16:33 | 2.206 | 0.7056 | 1.456 | (+) | | 12-1645-6634 | 17-4166-4421 | ENVIRON |
| 20 | | Nov | 5 | 16:00 | 1.894 | 0.3937 | 0.8126 | | | 13-9158-6969 | 12-9319-1772 | ENVIRON |
| 21 | | Dec | 4 | 15:55 | 1.68 | 0.1796 | 0.3708 | | | 05-0232-3049 | 00-1680-9936 | ENVIRON |

# CETIS QC Plot



**Reference Toxicant 96-h Acute Survival Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Survival | **Organism:** | Neanthes arenaceodentata (Polycha | **Material:** | Unionized Ammonia |
| **Protocol:** | PSEP (1995) | **Endpoint:** | Proportion Survived | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 1.181 | **Count:** | 20 | **-1s Warning Limit:** | 0.706 | **-2s Action Limit:** | 0.2307 |
| **Sigma:** | 0.4752 | **CV:** | 40.20% | **+1s Warning Limit:** | 1.656 | **+2s Action Limit:** | 2.132 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2013 | Dec | 20 | 14:00 | 1.228 | 0.047 | 0.09891 | | | 01-5055-0133 | 05-3710-3857 | NewFields |
| 2 | 2014 | Jan | 24 | 13:20 | 0.75 | -0.431 | -0.907 | | | 09-1104-1497 | 11-9980-1624 | NewFields |
| 3 | | Apr | 4 | 15:40 | 1.759 | 0.578 | 1.216 | (+) | | 00-6512-2526 | 16-4646-7758 | NewFields |
| 4 | | May | 30 | 16:25 | 0.494 | -0.687 | -1.446 | (-) | | 04-6747-6619 | 20-5692-2184 | ENVIRON |
| 5 | | Jun | 6 | 14:00 | 1.056 | -0.125 | -0.263 | | | 19-7971-8908 | 15-9945-9119 | ENVIRON |
| 6 | | | 20 | 13:20 | 1.898 | 0.717 | 1.509 | (+) | | 01-9511-3585 | 21-4292-7262 | ENVIRON |
| 7 | | Jul | 9 | 15:30 | 0.853 | -0.328 | -0.6902 | | | 09-1500-8488 | 15-2291-7760 | ENVIRON |
| 8 | | Aug | 22 | 12:30 | 1.227 | 0.046 | 0.0968 | | | 18-5611-8800 | 02-5634-5468 | ENVIRON |
| 9 | | Sep | 9 | 15:00 | 0.599 | -0.582 | -1.225 | (-) | | 18-5349-8839 | 09-1071-5088 | ENVIRON |
| 10 | | Nov | 14 | 11:11 | 1.391 | 0.21 | 0.4419 | | | 17-3054-3443 | 03-6925-5177 | ENVIRON |
| 11 | | Dec | 5 | 11:50 | 0.885 | -0.296 | -0.6229 | | | 14-0275-5265 | 10-6284-3142 | ENVIRON |
| 12 | | | 12 | 11:45 | 0.949 | -0.232 | -0.4882 | | | 04-5967-6225 | 18-7114-9710 | ENVIRON |
| 13 | 2015 | Jan | 16 | 11:15 | 1.723 | 0.542 | 1.141 | (+) | | 18-9719-6747 | 13-2446-7374 | ENVIRON |
| 14 | | Feb | 20 | 14:50 | 0.756 | -0.425 | -0.8944 | | | 15-6687-7653 | 19-8246-2320 | ENVIRON |
| 15 | | Mar | 6 | 11:50 | 1.333 | 0.152 | 0.3199 | | | 11-3697-1780 | 05-2303-0535 | ENVIRON |
| 16 | | Apr | 24 | 12:50 | 0.659 | -0.522 | -1.098 | (-) | | 01-0867-6874 | 18-8094-8803 | ENVIRON |
| 17 | | May | 15 | 14:00 | 0.85 | -0.331 | -0.6965 | | | 09-1275-9559 | 12-8836-8785 | ENVIRON |
| 18 | | Jul | 2 | 14:15 | 1.402 | 0.221 | 0.4651 | | | 12-0891-3679 | 17-1059-5211 | ENVIRON |
| 19 | | Aug | 21 | 16:33 | 2.184 | 1.003 | 2.111 | (+) | (+) | 12-1645-6634 | 17-2823-4932 | ENVIRON |
| 20 | | Nov | 5 | 16:00 | 1.627 | 0.446 | 0.9386 | | | 13-9158-6969 | 18-5085-3785 | ENVIRON |
| 21 | | Dec | 4 | 15:55 | 1.473 | 0.292 | 0.6145 | | | 05-0232-3049 | 09-1115-6716 | ENVIRON |

# CETIS Summary Report

Report Date: 09 Dec-15 14:23 (p 1 of 1)
Test Code: 5E9025CF | 15-8650-5167

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Batch ID:** | 08-6334-4077 | **Test Type:** | Survival | **Analyst:** | |
| **Start Date:** | 04 Dec-15 15:55 | **Protocol:** | PSEP (1995) | **Diluent:** | Laboratory Seawater |
| **Ending Date:** | 08 Dec-15 16:00 | **Species:** | Neanthes arenaceodentata | **Brine:** | Not Applicable |
| **Duration:** | 4d 0h | **Source:** | Aquatic Toxicology Support | **Age:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sample ID:** | 07-5789-2667 | **Code:** | 2D2C863B | **Client:** | Internal Lab |
| **Sample Date:** | 05 May-14 | **Material:** | Total Ammonia | **Project:** | Reference Toxicant |
| **Receive Date:** | 05 May-14 | **Source:** | Reference Toxicant | | |
| **Sample Age:** | 578d 16h | **Station:** | P140505.222 | | |

**Comparison Summary**

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 03-6544-2607 | Proportion Survived | 146 | 185 | 164.3 | NA | | Fisher Exact Test |

**Point Estimate Summary**

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 03-4063-5051 | Proportion Survived | EC50 | 169.2 | 163.9 | 174.7 | | Spearman-Kärber |

**Proportion Survived Summary**

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 85.5 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 146 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 185 | | 3 | 0.1 | 0 | 0.3484 | 0 | 0.2 | 0.05774 | 0.1 | 100.0% | 90.0% |
| 262 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 325 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

**Proportion Survived Detail**

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 85.5 | | 1 | 1 | 1 |
| 146 | | 1 | 1 | 1 |
| 185 | | 0.2 | 0 | 0.1 |
| 262 | | 0 | 0 | 0 |
| 325 | | 0 | 0 | 0 |

**Proportion Survived Binomials**

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 10/10 | 10/10 | 10/10 |
| 85.5 | | 10/10 | 10/10 | 10/10 |
| 146 | | 10/10 | 10/10 | 10/10 |
| 185 | | 2/10 | 0/10 | 1/10 |
| 262 | | 0/10 | 0/10 | 0/10 |
| 325 | | 0/10 | 0/10 | 0/10 |

## CETIS Test Data Worksheet

Report Date: 09 Dec-15 14:23 (p 1 of 1)
Test Code: 15-8650-5167/5E9025CF

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

**Start Date:** 04 Dec-15 15:55 **Species:** Neanthes arenaceodentata **Sample Code:** 2D2C863B
**End Date:** 08 Dec-15 16:00 **Protocol:** PSEP (1995) **Sample Source:** Reference Toxicant
**Sample Date:** 05 May-14 **Material:** Total Ammonia **Sample Station:** P140505.222

| C-mg/L | Code | Rep | Pos | # Exposed | # Survived | Notes |
|---|---|---|---|---|---|---|
| 0 | D | 1 | 12 | 10 | 10 | |
| 0 | D | 2 | 2 | 10 | 10 | |
| 0 | D | 3 | 10 | 10 | 10 | |
| 85.5 | | 1 | 9 | 10 | 10 | |
| 85.5 | | 2 | 6 | 10 | 10 | |
| 85.5 | | 3 | 18 | 10 | 10 | |
| 146 | | 1 | 7 | 10 | 10 | |
| 146 | | 2 | 17 | 10 | 10 | |
| 146 | | 3 | 11 | 10 | 10 | |
| 185 | | 1 | 14 | 10 | 2 | |
| 185 | | 2 | 4 | 10 | 0 | |
| 185 | | 3 | 5 | 10 | 1 | |
| 262 | | 1 | 3 | 10 | 0 | |
| 262 | | 2 | 16 | 10 | 0 | |
| 262 | | 3 | 13 | 10 | 0 | |
| 325 | | 1 | 15 | 10 | 0 | |
| 325 | | 2 | 1 | 10 | 0 | |
| 325 | | 3 | 8 | 10 | 0 | |

# CETIS Summary Report

**Report Date:** 09 Dec-15 14:30 (p 1 of 1)
**Test Code:** 1DF0D769 | 05-0232-3049

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Batch ID:** | 04-3678-3581 | **Test Type:** | Survival | **Analyst:** | |
| **Start Date:** | 04 Dec-15 15:55 | **Protocol:** | PSEP (1995) | **Diluent:** | Laboratory Seawater |
| **Ending Date:** | 08 Dec-15 16:00 | **Species:** | Neanthes arenaceodentata | **Brine:** | Not Applicable |
| **Duration:** | 4d 0h | **Source:** | Aquatic Toxicology Support | **Age:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sample ID:** | 05-6447-2130 | **Code:** | 21A52942 | **Client:** | Internal Lab |
| **Sample Date:** | 05 May-14 | **Material:** | Unionized Ammonia | **Project:** | Reference Toxicant |
| **Receive Date:** | 05 May-14 | **Source:** | Reference Toxicant | | |
| **Sample Age:** | 578d 16h | **Station:** | P140505.222 | | |

## Comparison Summary

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 09-1115-6716 | Proportion Survived | 1.473 | 1.852 | 1.652 | NA | | Fisher Exact Test |

## Point Estimate Summary

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 00-1680-9936 | Proportion Survived | EC50 | 1.68 | 1.649 | 1.711 | | Spearman-Kärber |

## Proportion Survived Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.357 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.473 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.852 | | 3 | 0.1 | 0 | 0.3484 | 0 | 0.2 | 0.05774 | 0.1 | 100.0% | 90.0% |
| 2.061 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 2.104 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

## Proportion Survived Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 1.357 | | 1 | 1 | 1 |
| 1.473 | | 1 | 1 | 1 |
| 1.852 | | 0.2 | 0 | 0.1 |
| 2.061 | | 0 | 0 | 0 |
| 2.104 | | 0 | 0 | 0 |

## Proportion Survived Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 10/10 | 10/10 | 10/10 |
| 1.357 | | 10/10 | 10/10 | 10/10 |
| 1.473 | | 10/10 | 10/10 | 10/10 |
| 1.852 | | 2/10 | 0/10 | 1/10 |
| 2.061 | | 0/10 | 0/10 | 0/10 |
| 2.104 | | 0/10 | 0/10 | 0/10 |

# CETIS Test Data Worksheet

**Report Date:** 09 Dec-15 14:29 (p 1 of 1)
**Test Code:** 05-0232-3049/1DF0D769

**Reference Toxicant 96-h Acute Survival Test** — **ENVIRON**

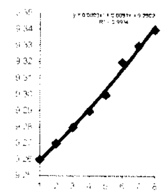
**Start Date:** 04 Dec-15 15:55 **Species:** Neanthes arenaceodentata **Sample Code:** 21A52942
**End Date:** 08 Dec-15 16:00 **Protocol:** PSEP (1995) **Sample Source:** Reference Toxicant
**Sample Date:** 05 May-14 **Material:** Unionized Ammonia **Sample Station:** P140505.222

| C-mg/L | Code | Rep | Pos | # Exposed | # Survived | Notes |
|---|---|---|---|---|---|---|
| 0 | D | 1 | 10 | 10 | 10 | |
| 0 | D | 2 | 8 | 10 | 10 | |
| 0 | D | 3 | 5 | 10 | 10 | |
| 1.357 | | 1 | 1 | 10 | 10 | |
| 1.357 | | 2 | 2 | 10 | 10 | |
| 1.357 | | 3 | 4 | 10 | 10 | |
| 1.473 | | 1 | 11 | 10 | 10 | |
| 1.473 | | 2 | 6 | 10 | 10 | |
| 1.473 | | 3 | 18 | 10 | 10 | |
| 1.852 | | 1 | 13 | 10 | 2 | |
| 1.852 | | 2 | 7 | 10 | 0 | |
| 1.852 | | 3 | 12 | 10 | 1 | |
| 2.061 | | 1 | 17 | 10 | 0 | |
| 2.061 | | 2 | 9 | 10 | 0 | |
| 2.061 | | 3 | 15 | 10 | 0 | |
| 2.104 | | 1 | 3 | 10 | 0 | |
| 2.104 | | 2 | 14 | 10 | 0 | |
| 2.104 | | 3 | 16 | 10 | 0 | |

| | | | |
|---|---|---|---|
| CLIENT: | GeoEngineers | Date of Test: | 04-Dec-15 |
| PROJECT: | RG Haley | Test Type: | Neanthes RT |
| COMMENTS: | P140505.222 | | |

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

| Integer: | I-factor |
|---|---|
| 1 | 9.26 |
| 2 | 9.27 |
| 3 | 9.28 |
| 4 | 9.29 |
| 5 | 9.30 |
| 6 | 9.32 |
| 7 | 9.33 |
| | 9.34 |



| | Sample | Mod | *NH3T (mg/L)* | *salinity (ppt)* | *pH* | *temp (C)* | temp (K) | i-factor | Mod | NH3U (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Target / Sample Name | | Actual | 22.9 | 8.0 | 24.1 | 297.26 | 9.3053 | | **#VALUE!** |
| | Example 3.5 | | 2.000 | 10.0 | 7.5 | 5.0 | 278.16 | 9.2750 | | **0.008** |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | 60 | | 85.5 | 27 | 7.7 | 19.4 | 292.56 | 9.3160 | | **1.357** |
| 5 | 100 | | 146 | 28 | 7.5 | 19.5 | 292.66 | 9.3187 | | **1.473** |
| 6 | 140 | | 185 | 28 | 7.5 | 19.4 | 292.56 | 9.3187 | | **1.852** |
| 7 | 180 | | 262 | 28 | 7.4 | 19.5 | 292.66 | 9.3187 | | **2.104** |
| 8 | 220 | | 325 | 28 | 7.3 | 19.4 | 292.56 | 9.3187 | | **2.061** |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 36 | | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | | | | | | | | | | |

ENVIRON

| CLIENT | PROJECT | SPECIES | LABORATORY | PROTOCOL |
|---|---|---|---|---|
| GeoEngineers | RG Haley | *Neanthes arenaceodentata* | Port Gamble | PSEP 1995 |

| JOB NUMBER | PROJECT MANAGER | TEST START DATE: | TIME | TEST END DATE | TIME |
|---|---|---|---|---|---|
| 0 | B. Hester | 04Dec15 | 1555 | 08Dec15 | 1600 |

| Test ID | LOT #: |
|---|---|
| P140505. ~~215~~ 222 ① | 32446535 |

## WATER QUALITY DATA

| DILTIN.WAT.BATCH | TEMP REC# | REFERENCE TOX. MATERIAL | REFERENCE TOXICANT |
|---|---|---|---|
| FSW120315.01 | | ammonium chloride | ammonia - TAN |

| TEST CONDITIONS | | | | | DO (mg/L) | | TEMP(C) | | SAL (ppt) | | pH | | TECHNICIAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | > 4.6 | | 20 ± 1 | | 28 ± 2 | | 7 - 9 | | |
| CLIENT/ ENVIRON ID | CONCENTRATION value | units | DAY | REP | D.O. meter | mg/L | TEMP. meter | °C | SALINITY meter | ppt | pH meter | unit | WQ TECH |
| Ref.Tox.- ammonia - TAN Target: | 0 | mg/L | 0 | Stock | 8 | 8.1 | 8 | 19.4 | 8 | 27 | 8 | 7.9 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 7.4 | 8 | 20.0 | 8 | 28 | 8 | 7.8 | BE 12/8 |
| Ref.Tox.- ammonia - TAN Target: | 60 | mg/L | 0 | Stock | 8 | 8.1 | 8 | 19.4 | 8 | 27 | 8 | 7.7 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 7.4 | 8 | 20.1 | 8 | 28 | 8 | 7.9 | BE 12/8 |
| Ref.Tox.- ammonia - TAN Target: | 100 | mg/L | 0 | Stock | 8 | 8.2 | 8 | 19.5 | 8 | 28 | 8 | 7.5 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 7.2 | 8 | 20.1 | 8 | 28 | 8 | 7.9 | BE 12/8 |
| Ref.Tox.- ammonia - TAN Target: | 140 | mg/L | 0 | Stock | 8 | 8.2 | 8 | 19.4 | 8 | 28 | 8 | 7.5 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 7.1 | 8 | 20.0 | 8 | 28 | 8 | 7.8 | BE 12/8 |
| Ref.Tox.- ammonia - TAN Target: | 180 | mg/L | 0 | Stock | 8 | 8.2 | 8 | 19.5 | 8 | 28 | 8 | 7.4 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 6.7 | 8 | 20.0 | 8 | 29 | 8 | 7.8 | BE 12/8 |
| Ref.Tox.- ammonia - TAN Target: | 220 | mg/L | 0 | Stock | 8 | 8.2 | 8 | 19.4 | 8 | 28 | 8 | 7.3 | JL 12/04 |
| Actual: | | | 4 | Rep 1 | 8 | 7.1 | 8 | 20.1 | 8 | 29 | 8 | 7.8 | BE 12/8 |

| CLIENT | PROJECT | JOB NUMBER | PROJECT MANAGER | LABORATORY | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 0 | B. Hester | Port Gamble | PSEP 1995 |

SPECIES: *Neanthes arenaceodentata*

## SURVIVAL & BEHAVIOR DATA

OBSERVATIONS KEY
N = normal
Q = quiescent
D = Discolored
F = Floating on surface

INITIAL # OF ORGANISMS: 10

| | | | | | DAY 1 | | | DAY 2 | | | DAY 3 | | | DAY 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE 12/05/15 | | | DATE 12/06 | | | DATE 12/7 | | | DATE 12/8/15 | | |
| | | | | | TECHNICIAN JL | | | TECHNICIAN JL | | | TECHNICIAN HZ | | | TECHNICIAN ① ~~BC~~ HZ | | |
| CLIENT/ ENVIRON ID | CONC. value | CONC. units | REP | INITIAL # if differs | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS | #ALIVE | #DEAD | OBS |
| Ref.Tox.- ammonia - TAN | 0 | mg/L | 1 | | 10 | 0 | N | 10 | 0 | N | 10 | 0 | N | 10 | 0 | N |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ |
| Ref.Tox.- ammonia - TAN | 60 | mg/L | 1 | | 10 | 0 | N | 10 | 0 | N | 10 | 0 | N | 10 | 0 | N |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ |
| Ref.Tox.- ammonia - TAN | 100 | mg/L | 1 | | 10 | 0 | N | 10 | 0 | Q | 10 | 0 | Q | 10 | 0 | Q |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 9 | ↓ |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ |
| Ref.Tox.- ammonia - TAN | 140 | mg/L | 1 | | 10 | 0 | N | 10 | 0 | Q | 10 | 0 | Q | 2 | 8 | Q |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 0 | 10 | ↓ |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 10 | 0 | ↓ | 1 | 9 | ↓ |
| Ref.Tox.- ammonia - TAN | 180 | mg/L | 1 | | 10 | 0 | N | 10 | 0 | Q | 10 | 0 | Q | 0 | 10 | ↓ |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 6 | 4 | ↓ | 0 | 6 | ↓ |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 5 | 5 | ↓ | 0 | 5 | ↓ |
| Ref.Tox.- ammonia - TAN | 220 | mg/L | 1 | | 10 | 0 | Q | 10 | 0 | Q | 4 | 6 | Q | 0 | ~~4~~ ② | / |
| | | | 2 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 0 | 10 | ↓ | | | |
| | | | 3 | | 10 | 0 | ↓ | 10 | 0 | ↓ | 0 | 10 | ↓ | | | |

① TE HZ 12/8  ② Illegible z HZ 12/8

ENVIRON **Ammonia Reference Toxicant Spiking Worksheet**

**Reference Toxicant ID:** P140505. ~~218~~ (1) 222
**Date Prepared:** 12/04/15
**Technician Initials:** JL

# Neanthes $NH_3$ RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 11/18/2015
Measurement: 8443.3

| Test Solutions | | | Volume of stock to reach desired concentration | |
|---|---|---|---|---|
| Measured Concentration | Desired Concentration | Volume | | |
| mg/L | mg/L | mL | mL stock to increase | |
| 0.00 | 0 | | [redacted] | SALT WATER (mL) |
| 35.5 | **60** | 750 | | 7.99 |
| 146 | **100** | 750 | | 13.32 |
| 185 | **140** | 750 | | 18.65 |
| 262 | **180** | 750 | | 23.98 |
| 325 | **220** | 750 | | 29.31 |
| | | | | |
| | | | | |
| | | | | |

(1) IE. JL 12/09/15.

# APPENDIX A.3.1

## *Mytilus galloprovincialis*

## Benthic Larval Bioassay

## Laboratory Data Sheets

ENVIRON

| | | | | | |
|---|---|---|---|---|---|
| | | | SPECIES *Mytilus galloprovincialis* | | |
| CLIENT GeoEngineers | PROJECT RG Haley | JOB NUMBER 0 | PROJECT MANAGER B. Hester | LAB / LOCATION Port Gamble / | PROTOCOL PSEP (1995) |
| ORGANISM BATCH | | TEST START DATE: 07 Dec. 15 | TIME 1749 | TEST END DATE: 09 Dec. 15 | TIME 1550 |

## LARVAL OBSERVATION DATA

| CLIENT/ ID | REP | NUMBER NORMAL | NUMBER | DATE | TECHNICIAN | COMMENTS |
|---|---|---|---|---|---|---|
| STOCKING DENSITY | 1 | | 265 | 12/17/15 | MARH | |
| | 2 | | 281 | | | |
| | 3 | | 268 | | | |
| | 4 | | 297 | | | |
| | 5 | | 289 | | | |
| Control / | 1 | 270 | 4 | | | |
| | 2 | 242 | 6 | | | |
| | 3 | 291 | 5 | | | |
| | 4 | 277 | 6 | | | |
| | 5 | 286 | 8 | | | |
| CR22 / | 1 | 206 | 4 | | | |
| | 2 | 256 | 6 | | | |
| | 3 | 266 | 2 | | | |
| | 4 | 264 | 5 | | | |
| | 5 | 202 | 3 | | | |
| SS1-SS-03-0-12 / | 1 | 219 | 3 | | | |
| | 2 | 234 | 5 | | | |
| | 3 | 183 | 3 | | | |
| | 4 | 274 | 1 | | | |
| | 5 | 236 | 2 | | | |

| CLIENT | PROJECT | JOB NUMBER | SPECIES | | |
|---|---|---|---|---|---|
| | | | *Mytilus galloprovincialis* | | |
| | | | **PROJECT MANAGER** | **LAB / LOCATION** | **PROTOCOL** |
| GeoEngineers | RG Haley | 0 | B. Hester | Port Gamble / | PSEP (1995) |

| ORGANISM BATCH | TEST START DATE: | TIME | TEST END DATE: | TIME |
|---|---|---|---|---|
| TS 120415 | 07 Dec 15 | 1749 | 09 Dec 15 | 1550 |

## LARVAL OBSERVATION DATA

| CLIENT/ ID | REP | NUMBER NORMAL | NUMBER | DATE | TECHNICIAN | COMMENTS |
|---|---|---|---|---|---|---|
| SS1-SS-05-0-12 / | 1 | 226 | 2 | 12/17/15 | MARH | |
| | 2 | 253 | 3 | | | |
| | 3 | 233 | 1 | | | |
| | 4 | 234 | 2 | | | |
| | 5 | 277 | 2 | | | |
| SS1-SS-06-0-12 / | 1 | 246 | 0 | | | |
| | 2 | 226 | 2 | | | |
| | 3 | 288 | 5 | | | |
| | 4 | 241 | 3 | | | |
| | 5 | 269 | 1 | | | |

ENVIRON

| CLIENT | PROJECT | SPECIES | | LAB / LOCATION | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | *Mytilus galloprovincialis* | | Port Gamble / | PSEP (1995) |
| **JOB NUMBER** | **PROJECT MANAGER** | **TEST START DATE** | **TIME** | **TEST END DATE** | **TIME** |
| 0 | B. Hester | 07Dec15 | 1749 | 09Dec15 | 1550 |

* Day 3&4 observations needed only if development endpoint not met by day 2

## WATER QUALITY DATA

| TEST CONDITIONS | | | | DO (mg/L) >5.0 | | Temp (°C) 16 ± 1 | | Sal (ppt) 28 ± 1 | | pH 7 - 9 | | Ammonia NA | | Sulfide NA | | TECH | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID | DAY | Random # | REP | D.O. | | TEMP. | | SALINITY | | pH | | AMMONIA | | SULFIDE | | | |
| | | | | meter | mg/L | meter | °C | meter | ppt | meter | unit | Techn. | mg/L (total) | Techn. | mg/L (Total) | | |
| Control / | 0 | | WQ Surr | 8 | 7.8 | 8 | 16.6 | 8 | 28 | 8 | 7.8 | RE | 0.00 | RE | 0.00 | RE | 12/7/15 |
| Control / | 1 | | WQ Surr | 8 | 7.7 | 8 | 16.5 | 8 | 28 | 8 | 7.7 | | | | | BE | 12/8/15 |
| Control / | 2 | | WQ Surr | 9 | 7.3 | 9 | 16.4 | 9 | 28 | 9 | 8.0 | JL | 0.00 | JL | 0.00 | JL | 12/09 |
| Control / | 3 | | WQ Surr | | | | | | | | | | | | | | |
| Control / | 4 | | WQ Surr | | | | | | | | | | | | | | |
| CR22 / | 0 | | WQ Surr | 8 | 7.4 | 8 | 16.8 | 8 | 28 | 8 | 7.9 | RE | 0.00 | RE | 0.134 | RE | 12/7/15 |
| CR22 / | 1 | | WQ Surr | 8 | 6.6 | 8 | 16.7 | 8 | 28 | 8 | 7.7 | | | | | BE | 12/8/15 |
| CR22 / | 2 | | WQ Surr | 9 | 6.0 | 9 | 16.3 | 9 | 28 | 9 | 7.8 | JL | 0.00 | JL | 0.005 | JL | 12/09 |
| CR22 / | 3 | | WQ Surr | | | | | | | | | | | | | | |
| CR22 / | 4 | | WQ Surr | | | | | | | | | | | | | | |
| SS1-SS-03-0-12 / | 0 | | WQ Surr | 8 | 6.9 | 8 | 16.9 | 8 | 28 | 8 | 7.9 | RE | 0.00 | RE | 0.098 | RE | 12/7/15 |
| SS1-SS-03-0-12 / | 1 | | WQ Surr | 8 | 5.6 | 8 | 16.3 | 8 | 28 | 8 | 7.9 | | | | | BE | 12/8/15 |
| SS1-SS-03-0-12 / | 2 | | WQ Surr | 9 | 6.1 | 9 | 16.4 | 9 | 28 | 9 | 7.8 | JL | 0.00 | JL | 0.00 | JL | 12/09 |
| SS1-SS-03-0-12 / | 3 | | WQ Surr | | | | | | | | | | | | | | |
| SS1-SS-03-0-12 / | 4 | | WQ Surr | | | | | | | | | | | | | | |

| CLIENT | PROJECT | SPECIES | | LAB / LOCATION | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | *Mytilus galloprovincialis* | | Port Gamble / | PSEP (1995) |
| **JOB NUMBER** | **PROJECT MANAGER** | **TEST START DATE** | **TIME** | **TEST END DATE** | **TIME** |
| 0 | B. Hester | 07Dec15 | 1749 | 09Dec15 | 1550 |

* Day 3&4 observations needed only if development endpoint not met by day 2

## WATER QUALITY DATA

| TEST CONDITIONS | | | | DO (mg/L) >5.0 | | Temp (°C) 16 ± 1 | | Sal (ppt) 28 ± 1 | | pH 7 - 9 | | Ammonia NA | | Sulfide NA | | TECH | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID | DAY | Random # | REP | D.O. | | TEMP. | | SALINITY | | pH | | AMMONIA | | SULFIDE | | | |
| | | | | meter | mg/L | meter | °C | meter | ppt | meter | unit | Techn. | mg/L (total) | Techn. | mg/L (Total) | | |
| SS1-SS-05-0-12 / | 0 | | WQ Surr | 8 | 7.6 | 8 | 16.7 | 8 | 28 | 8 | 8.0 | AE | 0.00 | KE | 0.072 | RE | 12/7/15 |
| SS1-SS-05-0-12 / | 1 | | WQ Surr | 8 | 6.3 | 8 | 16.6 | 8 | 28 | 8 | 7.9 | | | | | BE | 12/8/15 |
| SS1-SS-05-0-12 / | 2 | | WQ Surr | 9 | 5.6 | 9 | 16.7 | 9 | 28 | 9 | 7.8 | JL | 0.139 | JL | 0.00 | JL | 12/09 |
| SS1-SS-05-0-12 / | 3 | | WQ Surr | | | | | | | | | | | | | | |
| SS1-SS-05-0-12 / | 4 | | WQ Surr | | | | | | | | | | | | | | |
| SS1-SS-06-0-12 / | 0 | | WQ Surr | 8 | 7.5 | 8 | 16.8 | 8 | 28 | 8 | 8.0 | KE | 0.00 | KE | 0.050 | RE | 12/7/15 |
| SS1-SS-06-0-12 / | 1 | | WQ Surr | 8 | 5.6 | 8 | 16.9 | 8 | 28 | 8 | 7.9 | | | | | BE | 12/8/15 |
| SS1-SS-06-0-12 / | 2 | | WQ Surr | 9 | 6.2 | 9 | 16.4 | 9 | 28 | 9 | 7.8 | JL | 0.412 | JL | 0.00 | JL | 12/09 |
| SS1-SS-06-0-12 / | 3 | | WQ Surr | | | | | | | | | | | | | | |
| SS1-SS-06-0-12 / | 4 | | WQ Surr | | | | | | | | | | | | | | |

| CLIENT | PROJECT | JOB NUMBER | PROJECT MANAGER | LABORATORY | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 0 | B. Hester | Port Gamble | PSEP (1995) |

## TEST ORGANISM SPAWNING DATA

| | | | |
|---|---|---|---|
| SPECIES: *Mytilus galloprovincialis* | | | |
| SUPPLIER: Taylor Shellfish | | ORGANISM BATCH: TS120415 | |
| DATE RECEIVED: 12.04.15 | TIME RECEIVED: 1420 | DATE USED: 12.7.15 | |
| SPAWNING METHOD: feed/ heat shock | INITIAL SPAWNING TIME: 1435 | FINAL SPAWNING TIME: 1500 | |
| MALES: 3 | FEMALES: 3 | SPERM VIABILITY: ✓ | EGG CONDITION: Good |
| BEGIN FERTILIZATION: 1500 | END FERTILIZATION: 1749 | CONDITION OF EMBRYOS: >90% dev | |

| | |
|---|---|
| SAMPLE STORAGE | 4 Degrees Celsius - dark |
| SEDIMENT TREATMENT | none |
| TEST CHAMBERS | 1 L Mason Jars |
| EXPOSURE VOLUME | 900mL seawater / 18g Sediment |
| TIME OF SHAKE | 1212 |
| TIME OF INITIATION | 1749 |

## SPECIAL CONDITIONS

| UV LIGHT EXPOSURE (YES/NO) | AERATION FROM TEST INITIATION (YES/NO) |
|---|---|
| Yes | No |
| **SCREEN TUBE TEST (YES/NO)** | **OTHER (EXPLAIN)** |
| No | |

## EMBRYO DENSITY CALCULATIONS

$27 \times 100 = 2700$

$\frac{28000}{7500} = 3.7$ deliver

RT

$\frac{2700}{7500} = 0.36$

$100mL \cdot 0.36$ 36mL egg stock

64mL seawater

deliver 0.100mL

RAMBOLL ENVIRON

# ORGANISM RECEIPT LOG

**Date:** 12/04/15

**Time:** 1420

**Batch No.** TS120415

**Organism / Project:** Mytilus / RG Haley

**Source / Supplier:** Taylor Shellfish

**No. Ordered:** 12.15 16

**No. Received:** 12.15 16

**Source Batch:** Collection date, hatch date, etc.):

**Condition of Organisms:** Good

**Approximate Size or Age:** (Days from hatch, life stage, size class, etc.): Adult

**Shipper:** Courier

**B of L (Tracking No.)** NA

**Condition of Container:** Good

**Received By:** JL

| Container | D.O. (mg/L) | Temp. (°C) | Cond. or Sal. (Include Units) | pH (Units) | # Dead | % Dead* | Tech. (Initials) |
|---|---|---|---|---|---|---|---|
| * | | | | | | | JL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

*if >10% contact lab manager

**Notes:** * Received Dry.

# INVOICE DUE

Taylor Shellfish Farms
130 SE Lynch Rd
Shelton WA 98584
WA Cert.# 0046 SP

**BRIAN HESTER**

SHIP DATE
12/4/15

Name of Carrier:
**PICK UP AT RETAIL**

| | Description of product being shipped | |
|---|---|---|
| | 12.15 LB UNPROCESSED MUSSELS | 60.14 |
| | STYRO | 5.75 |
| | | 0 |
| | Thank you | |
| Total | | Total |
| | Balance Due | 65.89 |

our to less than 45° F prior to shipping.

Time:________ Date:________ Temp________

# APPENDIX A.3.2

## *Mytilus galloprovincialis*

## Benthic Larval Bioassay

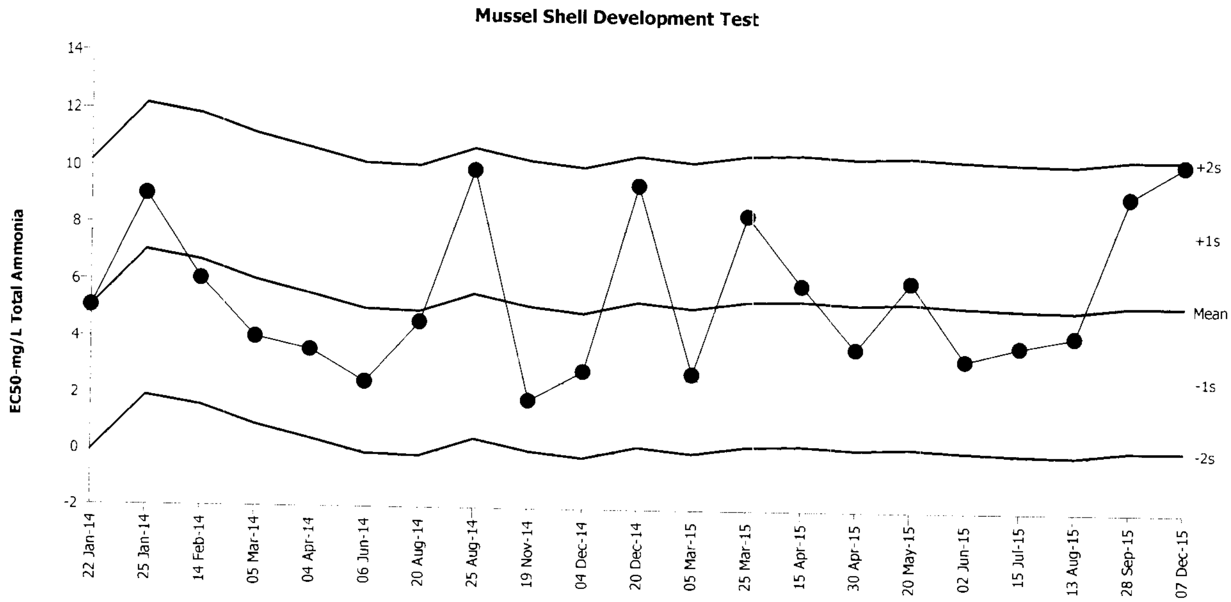
## Reference Toxicant Test

## CETIS QC Plot

**Report Date:** 20 Dec-15 18:19 ( 1 of 1)

**Mussel Shell Development Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Development-Survival | **Organism:** | Mytilus galloprovincialis (Bay Mussel | **Material:** | Total Ammonia |
| **Protocol:** | EPA/600/R-95/136 (1995) | **Endpoint:** | Combined Proportion Normal | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 5.348 | **Count:** | 20 | **-1s Warning Limit:** | 2.783 | **-2s Action Limit:** | 0.2176 |
| **Sigma:** | 2.565 | **CV:** | 48.00% | **+1s Warning Limit:** | 7.913 | **+2s Action Limit:** | 10.48 |

### Quality Control Data

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2014 | Jan | 22 | 18:47 | 5.072 | -0.2759 | -0.1076 | | | 13-2808-9359 | 13-2338-2483 | NewFields |
| 2 | | | 25 | 20:20 | 9.018 | 3.67 | 1.431 | (+) | | 14-2680-8854 | 01-2301-1257 | NewFields |
| 3 | | Feb | 14 | 15:45 | 6.063 | 0.715 | 0.2788 | | | 00-9581-0604 | 10-3047-2486 | NewFields |
| 4 | | Mar | 5 | 19:35 | 4.03 | -1.318 | -0.5138 | | | 00-1473-4954 | 06-0848-4308 | NewFields |
| 5 | | Apr | 4 | 19:30 | 3.594 | -1.754 | -0.6838 | | | 00-0374-9463 | 01-3815-4471 | Port Gamble Environment |
| 6 | | Jun | 6 | 18:15 | 2.465 | -2.883 | -1.124 | (-) | | 06-9491-1560 | 12-3152-8677 | ENVIRON |
| 7 | | Aug | 20 | 18:55 | 4.595 | -0.7527 | -0.2934 | | | 03-3666-4351 | 12-9663-9075 | ENVIRON |
| 8 | | | 25 | 19:45 | 9.954 | 4.606 | 1.796 | (+) | | 18-5120-4553 | 05-8275-9550 | ENVIRON |
| 9 | | Nov | 19 | 17:40 | 1.863 | -3.485 | -1.359 | (-) | | 16-6497-0143 | 19-4546-4847 | ENVIRON |
| 10 | | Dec | 4 | 17:10 | 2.911 | -2.437 | -0.95 | | | 16-3776-3251 | 02-2399-5582 | ENVIRON |
| 11 | | | 20 | 14:48 | 9.463 | 4.115 | 1.604 | (+) | | 18-9022-1075 | 07-2923-3003 | ENVIRON |
| 12 | 2015 | Mar | 5 | 17:00 | 2.844 | -2.504 | -0.9762 | | | 19-9854-1539 | 03-8736-8673 | ENVIRON |
| 13 | | | 25 | 17:44 | 8.428 | 3.08 | 1.201 | (+) | | 14-7108-3803 | 03-4995-0478 | ENVIRON |
| 14 | | Apr | 15 | 19:10 | 5.993 | 0.6452 | 0.2515 | | | 13-8932-4228 | 19-6133-3160 | ENVIRON |
| 15 | | | 30 | 18:04 | 3.781 | -1.567 | -0.611 | | | 20-6119-4159 | 02-4196-3961 | ENVIRON |
| 16 | | May | 20 | 17:25 | 6.135 | 0.7868 | 0.3067 | | | 09-2578-9028 | 09-4770-1274 | ENVIRON |
| 17 | | Jun | 2 | 17:40 | 3.4 | -1.948 | -0.7595 | | | 17-1514-2545 | 13-6694-9114 | ENVIRON |
| 18 | | Jul | 15 | 17:28 | 3.896 | -1.452 | -0.5659 | | | 03-2854-6295 | 19-5139-2675 | ENVIRON |
| 19 | | Aug | 13 | 17:12 | 4.263 | -1.085 | -0.423 | | | 11-0008-2350 | 17-0708-6345 | ENVIRON |
| 20 | | Sep | 28 | 19:46 | 9.184 | 3.836 | 1.495 | (+) | | 13-4113-2133 | 05-9076-7384 | ENVIRON |
| 21 | | Dec | 7 | 18:00 | 10.31 | 4.964 | 1.935 | (+) | | 08-2168-6467 | 19-8560-0099 | ENVIRON |



Analyst: ________ QA: ________

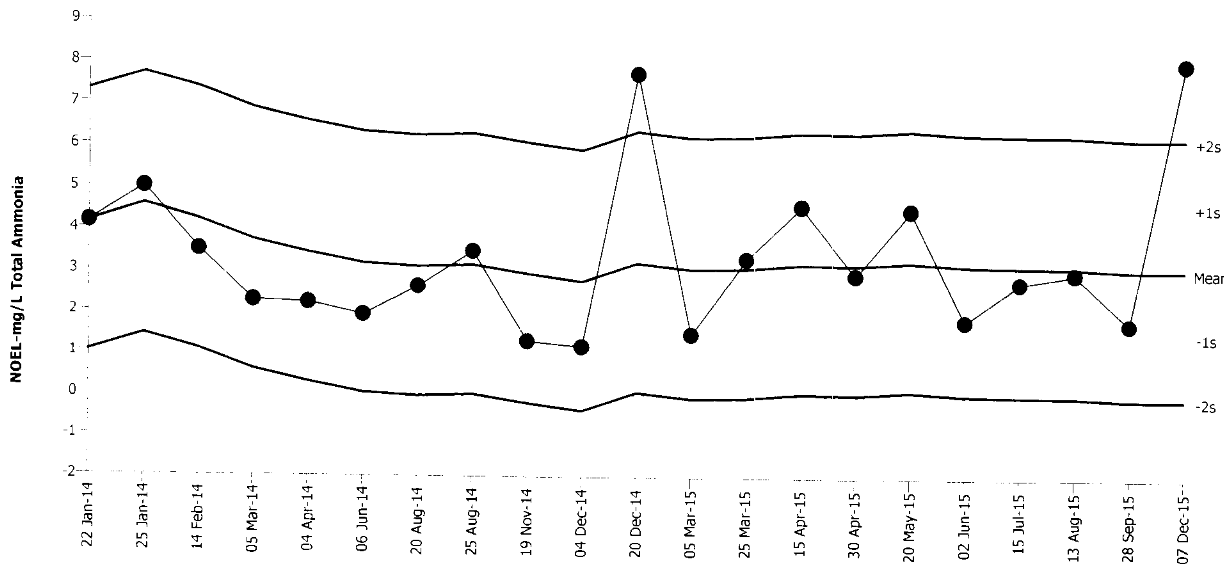
# CETIS QC Plot

**Report Date:** 20 Dec-15 18:19 ( 1 of 1)

**Mussel Shell Development Test** — **All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Development-Survival | **Organism:** | Mytilus galloprovincialis (Bay Mussel | **Material:** | Total Ammonia |
| **Protocol:** | EPA/600/R-95/136 (1995) | **Endpoint:** | Combined Proportion Normal | **Source:** | Reference Toxicant-REF |

**Mussel Shell Development Test**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 3.079 | **Count:** | 20 | **-1s Warning Limit:** | 1.507 | **-2s Action Limit:** | -0.0645 |
| **Sigma:** | 1.572 | **CV:** | 51.10% | **+1s Warning Limit:** | 4.651 | **+2s Action Limit:** | 6.223 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2014 | Jan | 22 | 18:47 | 4.16 | 1.081 | 0.6877 | | | 13-2808-9359 | 09-9457-8825 | NewFields |
| 2 | | | 25 | 20:20 | 4.99 | 1.911 | 1.216 | (+) | | 14-2680-8854 | 19-4144-0794 | NewFields |
| 3 | | Feb | 14 | 15:45 | 3.5 | 0.421 | 0.2678 | | | 00-9581-0604 | 14-2175-7836 | NewFields |
| 4 | | Mar | 5 | 19:35 | 2.27 | -0.809 | -0.5146 | | | 00-1473-4954 | 06-9188-5839 | NewFields |
| 5 | | Apr | 4 | 19:30 | 2.22 | -0.859 | -0.5464 | | | 00-0374-9463 | 13-5593-8276 | Port Gamble Environment |
| 6 | | Jun | 6 | 18:15 | 1.93 | -1.149 | -0.7309 | | | 06-9491-1560 | 15-1591-7876 | ENVIRON |
| 7 | | Aug | 20 | 18:55 | 2.62 | -0.459 | -0.292 | | | 03-3666-4351 | 02-5771-3266 | ENVIRON |
| 8 | | | 25 | 19:45 | 3.48 | 0.401 | 0.2551 | | | 18-5120-4553 | 02-0328-1110 | ENVIRON |
| 9 | | Nov | 19 | 17:40 | 1.3 | -1.779 | -1.132 | (-) | | 16-6497-0143 | 01-0463-0999 | ENVIRON |
| 10 | | Dec | 4 | 17:10 | 1.17 | -1.909 | -1.214 | (-) | | 16-3776-3251 | 12-6094-6851 | ENVIRON |
| 11 | | | 20 | 14:48 | 7.74 | 4.661 | 2.965 | (+) | (+) | 18-9022-1075 | 16-5805-5458 | ENVIRON |
| 12 | 2015 | Mar | 5 | 17:00 | 1.48 | -1.599 | -1.017 | (-) | | 19-9854-1539 | 01-8753-6379 | ENVIRON |
| 13 | | | 25 | 17:44 | 3.32 | 0.241 | 0.1533 | | | 14-7108-3803 | 13-7995-1182 | ENVIRON |
| 14 | | Apr | 15 | 19:10 | 4.59 | 1.511 | 0.9612 | | | 13-8932-4228 | 17-9791-4217 | ENVIRON |
| 15 | | | 30 | 18:04 | 2.94 | -0.139 | -0.08842 | | | 20-6119-4159 | 17-0732-0588 | ENVIRON |
| 16 | | May | 20 | 17:25 | 4.51 | 1.431 | 0.9103 | | | 09-2578-9028 | 13-7558-2393 | ENVIRON |
| 17 | | Jun | 2 | 17:40 | 1.83 | -1.249 | -0.7945 | | | 17-1514-2545 | 16-3284-8954 | ENVIRON |
| 18 | | Jul | 15 | 17:28 | 2.77 | -0.309 | -0.1966 | | | 03-2854-6295 | 02-6331-6633 | ENVIRON |
| 19 | | Aug | 13 | 17:12 | 3 | -0.079 | -0.05025 | | | 11-0008-2350 | 11-0317-1423 | ENVIRON |
| 20 | | Sep | 28 | 19:46 | 1.77 | -1.309 | -0.8327 | | | 13-4113-2133 | 01-4448-6063 | ENVIRON |
| 21 | | Dec | 7 | 18:00 | 8.03 | 4.951 | 3.149 | (+) | (+) | 08-2168-6467 | 11-6893-5917 | ENVIRON |

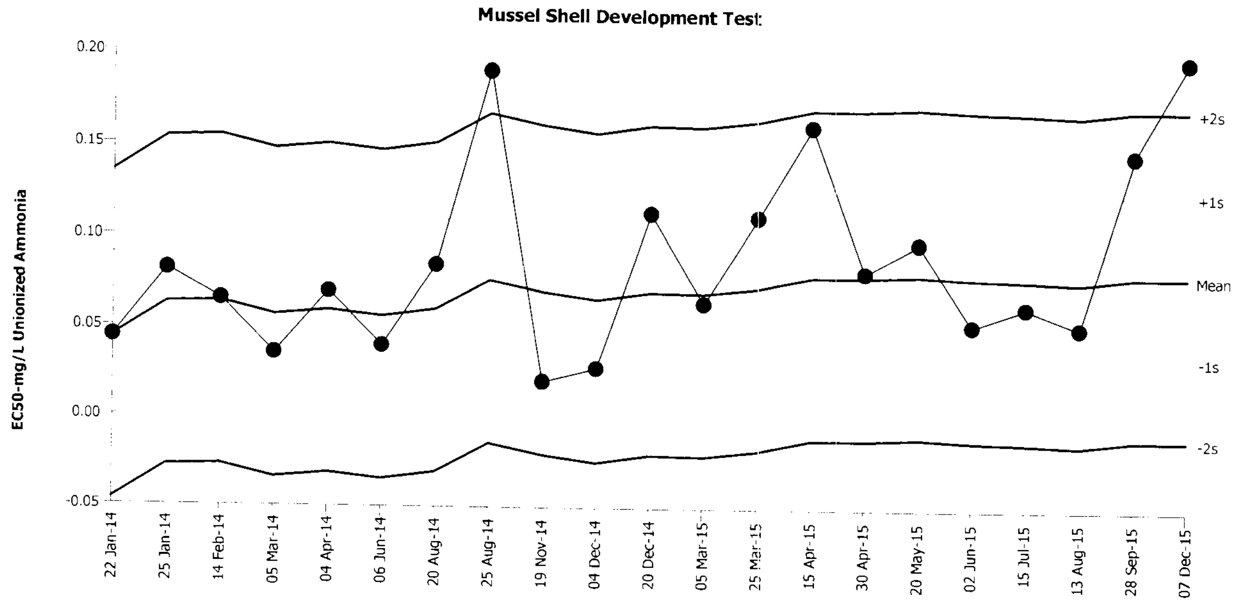
# CETIS QC Plot

**Report Date:** 20 Dec-15 18:23 ( 1 of 1)

**Mussel Shell Development Test**

**All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Development-Survival | **Organism:** | Mytilus galloprovincialis (Bay Mussel | **Material:** | Unionized Ammonia |
| **Protocol:** | EPA/600/R-95/136 (1995) | **Endpoint:** | Combined Proportion Normal | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 0.08023 | **Count:** | 20 | **-1s Warning Limit:** | 0.03485 | **-2s Action Limit:** | -0.0105 |
| **Sigma:** | 0.04538 | **CV:** | 56.60% | **+1s Warning Limit:** | 0.1256 | **+2s Action Limit:** | 0.171 |

## Quality Control Data

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2014 | Jan | 22 | 18:47 | 0.04434 | -0.03589 | -0.7909 | | | 15-7285-0453 | 02-5494-3481 | NewFields |
| 2 | | | 25 | 20:20 | 0.08179 | 0.001555 | 0.03427 | | | 04-0859-3739 | 09-7301-2928 | NewFields |
| 3 | | Feb | 14 | 15:45 | 0.0653 | -0.01493 | -0.329 | | | 15-0233-5150 | 16-5673-1462 | NewFields |
| 4 | | Mar | 5 | 19:35 | 0.03552 | -0.04471 | -0.9851 | | | 02-2074-6026 | 13-5083-6151 | NewFields |
| 5 | | Apr | 4 | 19:30 | 0.06967 | -0.01056 | -0.2326 | | | 08-9987-7352 | 06-2075-5011 | Port Gamble Environment |
| 6 | | Jun | 6 | 18:15 | 0.03982 | -0.04041 | -0.8904 | | | 20-1079-3686 | 12-0135-9289 | ENVIRON |
| 7 | | Aug | 20 | 18:55 | 0.08475 | 0.004517 | 0.09953 | | | 14-9751-1227 | 04-1532-7472 | ENVIRON |
| 8 | | | 25 | 19:45 | 0.1905 | 0.1103 | 2.43 | (+) | (+) | 00-8792-7550 | 08-9753-5531 | ENVIRON |
| 9 | | Nov | 19 | 17:40 | 0.0203 | -0.05993 | -1.321 | (-) | | 06-3984-9090 | 13-7269-9515 | ENVIRON |
| 10 | | Dec | 4 | 17:10 | 0.02788 | -0.05235 | -1.154 | (-) | | 12-3986-2462 | 11-3972-7037 | ENVIRON |
| 11 | | | 20 | 14:48 | 0.1135 | 0.03323 | 0.7323 | | | 09-9287-5419 | 07-6460-4486 | ENVIRON |
| 12 | 2015 | Mar | 5 | 17:00 | 0.06436 | -0.01587 | -0.3496 | | | 13-3685-7547 | 03-1524-4615 | ENVIRON |
| 13 | | | 25 | 17:44 | 0.1116 | 0.03133 | 0.6904 | | | 08-9075-8262 | 10-9676-7365 | ENVIRON |
| 14 | | Apr | 15 | 19:10 | 0.1609 | 0.08065 | 1.777 | (+) | | 16-8535-8797 | 10-1479-4973 | ENVIRON |
| 15 | | | 30 | 18:04 | 0.08192 | 0.001686 | 0.03715 | | | 03-9240-3383 | 09-4512-5047 | ENVIRON |
| 16 | | May | 20 | 17:25 | 0.09802 | 0.01779 | 0.3919 | | | 02-2718-1762 | 05-2499-4463 | ENVIRON |
| 17 | | Jun | 2 | 17:40 | 0.05293 | -0.0273 | -0.6015 | | | 05-0395-8879 | 02-8689-2030 | ENVIRON |
| 18 | | Jul | 15 | 17:28 | 0.06313 | -0.0171 | -0.3768 | | | 00-2296-0969 | 17-0196-9853 | ENVIRON |
| 19 | | Aug | 13 | 17:12 | 0.05202 | -0.02821 | -0.6217 | | | 20-0843-4308 | 07-3272-8799 | ENVIRON |
| 20 | | Sep | 28 | 19:46 | 0.1464 | 0.06613 | 1.457 | (+) | | 14-0799-9245 | 10-1527-0979 | ENVIRON |
| 21 | | Dec | 7 | 18:00 | 0.1977 | 0.1175 | 2.59 | (+) | (+) | 14-1153-0185 | 08-9940-5879 | ENVIRON |

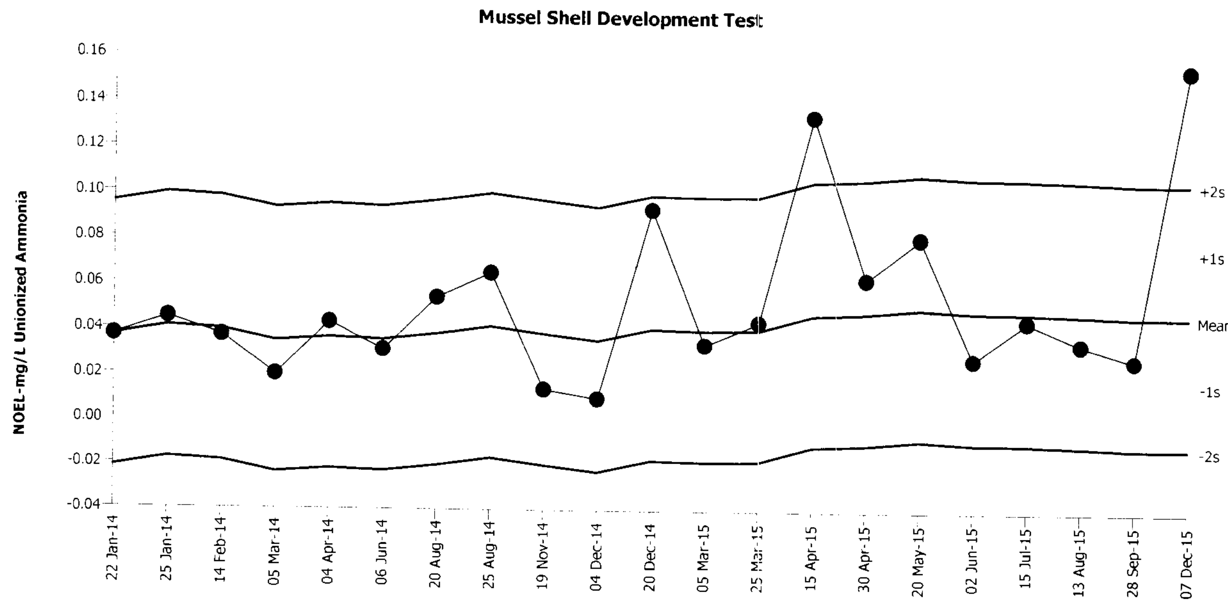
# CETIS QC Plot

**Report Date:** 20 Dec-15 18:23 ( 1 of 1)

**Mussel Shell Development Test**

**All Matching Labs**

| | | | | | |
|---|---|---|---|---|---|
| **Test Type:** | Development-Survival | **Organism:** | Mytilus galloprovincialis (Bay Mussel | **Material:** | Unionized Ammonia |
| **Protocol:** | EPA/600/R-95/136 (1995) | **Endpoint:** | Combined Proportion Normal | **Source:** | Reference Toxicant-REF |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mean:** | 0.04705 | **Count:** | 20 | **-1s Warning Limit:** | 0.01787 | **-2s Action Limit:** | -0.0113 |
| **Sigma:** | 0.02918 | **CV:** | 62.00% | **+1s Warning Limit:** | 0.07623 | **+2s Action Limit:** | 0.1054 |

**Quality Control Data**

| Point | Year | Month | Day | Time | QC Data | Delta | Sigma | Warning | Action | Test ID | Analysis ID | Laboratory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2014 | Jan | 22 | 18:47 | 0.037 | -0.01005 | -0.3444 | | | 15-7285-0453 | 12-0010-0113 | NewFields |
| 2 | | | 25 | 20:20 | 0.045 | -0.00205 | -0.07025 | | | 04-0859-3739 | 20-3446-9116 | NewFields |
| 3 | | Feb | 14 | 15:45 | 0.037 | -0.01005 | -0.3444 | | | 15-0233-5150 | 19-2470-0896 | NewFields |
| 4 | | Mar | 5 | 19:35 | 0.02 | -0.02705 | -0.927 | | | 02-2074-6026 | 10-8335-1484 | NewFields |
| 5 | | Apr | 4 | 19:30 | 0.043 | -0.00405 | -0.1388 | | | 08-9987-7352 | 01-2582-7818 | Port Gamble Environment |
| 6 | | Jun | 6 | 18:15 | 0.031 | -0.01605 | -0.55 | | | 20-1079-3686 | 02-2339-8824 | ENVIRON |
| 7 | | Aug | 20 | 18:55 | 0.054 | 0.00695 | 0.2382 | | | 14-9751-1227 | 13-4768-2245 | ENVIRON |
| 8 | | | 25 | 19:45 | 0.065 | 0.01795 | 0.6151 | | | 00-8792-7550 | 14-4895-9621 | ENVIRON |
| 9 | | Nov | 19 | 17:40 | 0.014 | -0.03305 | -1.133 | (-) | | 06-3984-9090 | 04-2355-4660 | ENVIRON |
| 10 | | Dec | 4 | 17:10 | 0.01 | -0.03705 | -1.27 | (-) | | 12-3986-2462 | 15-5042-0469 | ENVIRON |
| 11 | | | 20 | 14:48 | 0.093 | 0.04595 | 1.575 | (+) | | 09-9287-5419 | 18-5647-4199 | ENVIRON |
| 12 | 2015 | Mar | 5 | 17:00 | 0.034 | -0.01305 | -0.4472 | | | 13-3685-7547 | 15-2807-2719 | ENVIRON |
| 13 | | | 25 | 17:44 | 0.044 | -0.00305 | -0.1045 | | | 08-9075-8262 | 05-7869-3859 | ENVIRON |
| 14 | | Apr | 15 | 19:10 | 0.134 | 0.08695 | 2.98 | (+) | (+) | 16-8535-8797 | 14-3122-1198 | ENVIRON |
| 15 | | | 30 | 18:04 | 0.063 | 0.01595 | 0.5466 | | | 03-9240-3383 | 00-2807-5882 | ENVIRON |
| 16 | | May | 20 | 17:25 | 0.081 | 0.03395 | 1.163 | (+) | | 02-2718-1762 | 04-5934-5151 | ENVIRON |
| 17 | | Jun | 2 | 17:40 | 0.028 | -0.01905 | -0.6528 | | | 05-0395-8879 | 14-7577-7111 | ENVIRON |
| 18 | | Jul | 15 | 17:28 | 0.045 | -0.00205 | -0.07025 | | | 00-2296-0969 | 19-0657-0188 | ENVIRON |
| 19 | | Aug | 13 | 17:12 | 0.035 | -0.01205 | -0.413 | | | 20-0843-4308 | 02-2615-4019 | ENVIRON |
| 20 | | Sep | 28 | 19:46 | 0.028 | -0.01905 | -0.6528 | | | 14-0799-9245 | 09-3291-9362 | ENVIRON |
| 21 | | Dec | 7 | 18:00 | 0.155 | 0.108 | 3.699 | (+) | (+) | 14-1153-0185 | 11-3892-1501 | ENVIRON |



Analyst: JL QA:_______

# CETIS Summary Report



## Mussel Shell Development Test

ENVIRON

| | | | | | |
|---|---|---|---|---|---|
| Batch ID: | 02-9949-9063 | Test Type: | Development-Survival | Analyst: | |
| Start Date: | 07 Dec-15 18:00 | Protocol: | EPA/600/R-95/136 (1995) | Diluent: | Laboratory Seawater |
| Ending Date: | 09 Dec-15 16:00 | Species: | Mytilus galloprovincialis | Brine: | Not Applicable |
| Duration: | 46h | Source: | Taylor Shellfish | Age: | |

| | | | | | |
|---|---|---|---|---|---|
| Sample ID: | 21-4174-5971 | Code: | 7FA87333 | Client: | Internal Lab |
| Sample Date: | 05 May-14 | Material: | Total Ammonia | Project: | Reference Toxicant |
| Receive Date: | 05 May-14 | Source: | Reference Toxicant | | |
| Sample Age: | 581d 18h | Station: | p140505.220 | | |

### Comparison Summary

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 11-6893-5917 | Combined Proportion Norm | 8.03 | 14.1 | 10.64 | NA | | Fisher Exact Test |
| 18-8425-2751 | Proportion Normal | 2.38 | 8.03 | 4.372 | NA | | Fisher Exact Test |
| 20-9567-7795 | Proportion Survived | 21 | >21 | NA | NA | | Fisher Exact Test |

### Point Estimate Summary

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 19-8560-0099 | Combined Proportion Norm | EC50 | 10.31 | 10.19 | 10.43 | | Spearman-Kärber |
| 01-4207-7317 | Proportion Normal | EC50 | 10.45 | 10.36 | 10.54 | | Spearman-Kärber |
| 13-9333-1985 | Proportion Survived | EC5 | >21 | N/A | N/A | | Linear Interpolation (ICPIN) |
| | | EC10 | >21 | N/A | N/A | | |
| | | EC15 | >21 | N/A | N/A | | |
| | | EC20 | >21 | N/A | N/A | | |
| | | EC25 | >21 | N/A | N/A | | |
| | | EC40 | >21 | N/A | N/A | | |
| | | EC50 | >21 | N/A | N/A | | |

### Test Acceptability

| Analysis ID | Endpoint | Attribute | Test Stat | TAC Limits | Overlap | Decision |
|---|---|---|---|---|---|---|
| 01-4207-7317 | Proportion Normal | Control Resp | 0.9826 | 0.9 - NL | Yes | Passes Acceptability Criteria |
| 18-8425-2751 | Proportion Normal | Control Resp | 0.9826 | 0.9 - NL | Yes | Passes Acceptability Criteria |
| 13-9333-1985 | Proportion Survived | Control Resp | 1 | 0.5 - NL | Yes | Passes Acceptability Criteria |
| 20-9567-7795 | Proportion Survived | Control Resp | 1 | 0.5 - NL | Yes | Passes Acceptability Criteria |



Analyst: JV QA: ______

**Mussel Shell Development Test** **ENVIRON**

### Combined Proportion Normal Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.583 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.53 | | 3 | 0.9587 | 0.7809 | 1 | 0.8761 | 1 | 0.04131 | 0.07155 | 7.46% | 4.13% |
| 2.38 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 8.03 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 14.1 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 21 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

### Proportion Normal Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 0.9826 | 0.9603 | 1 | 0.9746 | 0.9924 | 0.005199 | 0.009005 | 0.92% | 0.0% |
| 0.583 | | 3 | 0.9766 | 0.9547 | 0.9984 | 0.9686 | 0.986 | 0.005074 | 0.008788 | 0.9% | 0.62% |
| 1.53 | | 3 | 0.9759 | 0.9431 | 1 | 0.9624 | 0.9888 | 0.007615 | 0.01319 | 1.35% | 0.69% |
| 2.38 | | 3 | 0.9945 | 0.9881 | 1 | 0.9916 | 0.9962 | 0.001494 | 0.002588 | 0.26% | -1.21% |
| 8.03 | | 3 | 0.9631 | 0.9426 | 0.9835 | 0.9539 | 0.9698 | 0.004752 | 0.008231 | 0.85% | 1.99% |
| 14.1 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 21 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

### Proportion Survived Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.583 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 1.53 | | 3 | 0.9701 | 0.8414 | 1 | 0.9103 | 1 | 0.02991 | 0.05181 | 5.34% | 2.99% |
| 2.38 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 8.03 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 14.1 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 21 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |

**Mussel Shell Development Test**

**ENVIRON**

### Combined Proportion Normal Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 0.583 | | 1 | 1 | 1 |
| 1.53 | | 1 | 1 | 0.8761 |
| 2.38 | | 1 | 1 | 1 |
| 8.03 | | 1 | 1 | 1 |
| 14.1 | | 0 | 0 | 0 |
| 21 | | 0 | 0 | 0 |

### Proportion Normal Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 0.9746 | 0.9924 | 0.9809 |
| 0.583 | | 0.9751 | 0.9686 | 0.986 |
| 1.53 | | 0.9888 | 0.9764 | 0.9624 |
| 2.38 | | 0.9958 | 0.9916 | 0.9962 |
| 8.03 | | 0.9655 | 0.9698 | 0.9539 |
| 14.1 | | 0 | 0 | 0 |
| 21 | | 0 | 0 | 0 |

### Proportion Survived Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 0.583 | | 1 | 1 | 1 |
| 1.53 | | 1 | 1 | 0.9103 |
| 2.38 | | 1 | 1 | 1 |
| 8.03 | | 1 | 1 | 1 |
| 14.1 | | 1 | 1 | 1 |
| 21 | | 1 | 1 | 1 |

## Combined Proportion Normal Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 269/269 | 261/261 | 257/257 |
| 0.583 | | 274/274 | 247/247 | 282/282 |
| 1.53 | | 265/265 | 248/248 | 205/234 |
| 2.38 | | 238/238 | 235/235 | 265/265 |
| 8.03 | | 252/252 | 257/257 | 269/269 |
| 14.1 | | 0/234 | 0/234 | 0/234 |
| 21 | | 0/234 | 0/234 | 0/234 |

## Proportion Normal Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 269/276 | 261/263 | 257/262 |
| 0.583 | | 274/281 | 247/255 | 282/286 |
| 1.53 | | 265/268 | 248/254 | 205/213 |
| 2.38 | | 238/239 | 235/237 | 265/266 |
| 8.03 | | 252/261 | 257/265 | 269/282 |
| 14.1 | | 0/264 | 0/266 | 0/269 |
| 21 | | 0/288 | 0/240 | 0/276 |

## Proportion Survived Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 234/234 | 234/234 | 234/234 |
| 0.583 | | 234/234 | 234/234 | 234/234 |
| 1.53 | | 234/234 | 234/234 | 213/234 |
| 2.38 | | 234/234 | 234/234 | 234/234 |
| 8.03 | | 234/234 | 234/234 | 234/234 |
| 14.1 | | 234/234 | 234/234 | 234/234 |
| 21 | | 234/234 | 234/234 | 234/234 |

# CETIS Test Data Worksheet

Report Date: 20 Dec-15 18:17 (p 1 of 1)
Test Code: 08-2168-6467/30F9F0C3

**Mussel Shell Development Test** — **ENVIRON**

| | | | | | |
|---|---|---|---|---|---|
| **Start Date:** | 07 Dec-15 18:00 | **Species:** | Mytilus galloprovincialis | **Sample Code:** | 7FA87333 |
| **End Date:** | 09 Dec-15 16:00 | **Protocol:** | EPA/600/R-95/136 (1995) | **Sample Source:** | Reference Toxicant |
| **Sample Date:** | 05 May-14 | **Material:** | Total Ammonia | **Sample Station:** | p140505.220 |

| C-mg/L | Code | Rep | Pos | Initial Density | Final Density | # Counted | # Normal | Notes |
|---|---|---|---|---|---|---|---|---|
| 0 | D | 1 | 1 | 234 | 276 | 276 | 269 | |
| 0 | D | 2 | 2 | 234 | 263 | 263 | 261 | |
| 0 | D | 3 | 3 | 234 | 262 | 262 | 257 | |
| 0.583 | | 1 | 4 | 234 | 281 | 281 | 274 | |
| 0.583 | | 2 | 5 | 234 | 255 | 255 | 247 | |
| 0.583 | | 3 | 6 | 234 | 286 | 286 | 282 | |
| 1.53 | | 1 | 7 | 234 | 268 | 268 | 265 | |
| 1.53 | | 2 | 8 | 234 | 254 | 254 | 248 | |
| 1.53 | | 3 | 9 | 234 | 213 | 213 | 205 | |
| 2.38 | | 1 | 10 | 234 | 239 | 239 | 238 | |
| 2.38 | | 2 | 11 | 234 | 237 | 237 | 235 | |
| 2.38 | | 3 | 12 | 234 | 266 | 266 | 265 | |
| 8.03 | | 1 | 13 | 234 | 261 | 261 | 252 | |
| 8.03 | | 2 | 14 | 234 | 265 | 265 | 257 | |
| 8.03 | | 3 | 15 | 234 | 282 | 282 | 269 | |
| 14.1 | | 1 | 16 | 234 | 264 | 264 | 0 | |
| 14.1 | | 2 | 17 | 234 | 266 | 266 | 0 | |
| 14.1 | | 3 | 18 | 234 | 269 | 269 | 0 | |
| 21 | | 1 | 19 | 234 | 288 | 288 | 0 | |
| 21 | | 2 | 20 | 234 | 240 | 240 | 0 | |
| 21 | | 3 | 21 | 234 | 276 | 276 | 0 | |

# CETIS Summary Report

Report Date: 20 Dec-15 18:23 (p 1 of 4)
Test Code: 54223DC9 | 14-1153-0185

**Mussel Shell Development Test**

ENVIRON

| | | | | | |
|---|---|---|---|---|---|
| **Batch ID:** | 01-8925-9245 | **Test Type:** | Development-Survival | **Analyst:** | |
| **Start Date:** | 07 Dec-15 18:00 | **Protocol:** | EPA/600/R-95/136 (1995) | **Diluent:** | Laboratory Seawater |
| **Ending Date:** | 09 Dec-15 16:00 | **Species:** | Mytilus galloprovincialis | **Brine:** | Not Applicable |
| **Duration:** | 46h | **Source:** | Taylor Shellfish | **Age:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sample ID:** | 17-5692-0473 | **Code:** | 68B87A99 | **Client:** | Internal Lab |
| **Sample Date:** | 05 May-14 | **Material:** | Unionized Ammonia | **Project:** | Reference Toxicant |
| **Receive Date:** | 05 May-14 | **Source:** | Reference Toxicant | | |
| **Sample Age:** | 581d 18h | **Station:** | p140505.220 | | |

**Comparison Summary**

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|---|---|---|---|---|---|---|---|
| 11-3892-1501 | Combined Proportion Norm | 0.155 | 0.267 | 0.2034 | NA | | Fisher Exact Test |
| 07-7760-7002 | Proportion Normal | 0.058 | 0.155 | 0.09482 | NA | | Fisher Exact Test |
| 10-4690-5686 | Proportion Survived | 0.397 | >0.397 | NA | NA | | Fisher Exact Test |

**Point Estimate Summary**

| Analysis ID | Endpoint | Level | mg/L | 95% LCL | 95% UCL | TU | Method |
|---|---|---|---|---|---|---|---|
| 08-9940-5879 | Combined Proportion Norm | EC50 | 0.1977 | 0.1957 | 0.1998 | | Spearman-Kärber |
| 11-4665-5338 | Proportion Normal | EC50 | 0.2003 | 0.1988 | 0.2018 | | Spearman-Kärber |
| 15-9190-5272 | Proportion Survived | EC5 | >0.397 | N/A | N/A | | Linear Interpolation (ICPIN) |
| | | EC10 | >0.397 | N/A | N/A | | |
| | | EC15 | >0.397 | N/A | N/A | | |
| | | EC20 | >0.397 | N/A | N/A | | |
| | | EC25 | >0.397 | N/A | N/A | | |
| | | EC40 | >0.397 | N/A | N/A | | |
| | | EC50 | >0.397 | N/A | N/A | | |

**Test Acceptability**

| Analysis ID | Endpoint | Attribute | Test Stat | TAC Limits | Overlap | Decision |
|---|---|---|---|---|---|---|
| 07-7760-7002 | Proportion Normal | Control Resp | 0.9826 | 0.9 - NL | Yes | Passes Acceptability Criteria |
| 11-4665-5338 | Proportion Normal | Control Resp | 0.9826 | 0.9 - NL | Yes | Passes Acceptability Criteria |
| 10-4690-5686 | Proportion Survived | Control Resp | 1 | 0.5 - NL | Yes | Passes Acceptability Criteria |
| 15-9190-5272 | Proportion Survived | Control Resp | 1 | 0.5 - NL | Yes | Passes Acceptability Criteria |

Mussel Shell Development Test

ENVIRON

### Combined Proportion Normal Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.014 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.037 | | 3 | 0.9587 | 0.7809 | 1 | 0.8761 | 1 | 0.04131 | 0.07155 | 7.46% | 4.13% |
| 0.058 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.155 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.267 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 0.397 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

### Proportion Normal Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 0.9826 | 0.9603 | 1 | 0.9746 | 0.9924 | 0.005199 | 0.009005 | 0.92% | 0.0% |
| 0.014 | | 3 | 0.9766 | 0.9547 | 0.9984 | 0.9686 | 0.986 | 0.005074 | 0.008788 | 0.9% | 0.62% |
| 0.037 | | 3 | 0.9759 | 0.9431 | 1 | 0.9624 | 0.9888 | 0.007615 | 0.01319 | 1.35% | 0.69% |
| 0.058 | | 3 | 0.9945 | 0.9881 | 1 | 0.9916 | 0.9962 | 0.001494 | 0.002588 | 0.26% | -1.21% |
| 0.155 | | 3 | 0.9631 | 0.9426 | 0.9835 | 0.9539 | 0.9698 | 0.004752 | 0.008231 | 0.85% | 1.99% |
| 0.267 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |
| 0.397 | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 100.0% |

### Proportion Survived Summary

| C-mg/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dilution Water | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.014 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.037 | | 3 | 0.9701 | 0.8414 | 1 | 0.9103 | 1 | 0.02991 | 0.05181 | 5.34% | 2.99% |
| 0.058 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.155 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.267 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| 0.397 | | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |

# CETIS Summary Report

Report Date: 20 Dec-15 18:23 (p 3 of 4)
Test Code: 54223DC9 | 14-1153-0185

Mussel Shell Development Test

ENVIRON

### Combined Proportion Normal Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 0.014 | | 1 | 1 | 1 |
| 0.037 | | 1 | 1 | 0.8761 |
| 0.058 | | 1 | 1 | 1 |
| 0.155 | | 1 | 1 | 1 |
| 0.267 | | 0 | 0 | 0 |
| 0.397 | | 0 | 0 | 0 |

### Proportion Normal Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 0.9746 | 0.9924 | 0.9809 |
| 0.014 | | 0.9751 | 0.9686 | 0.986 |
| 0.037 | | 0.9888 | 0.9764 | 0.9624 |
| 0.058 | | 0.9958 | 0.9916 | 0.9962 |
| 0.155 | | 0.9655 | 0.9698 | 0.9539 |
| 0.267 | | 0 | 0 | 0 |
| 0.397 | | 0 | 0 | 0 |

### Proportion Survived Detail

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 1 | 1 | 1 |
| 0.014 | | 1 | 1 | 1 |
| 0.037 | | 1 | 1 | 0.9103 |
| 0.058 | | 1 | 1 | 1 |
| 0.155 | | 1 | 1 | 1 |
| 0.267 | | 1 | 1 | 1 |
| 0.397 | | 1 | 1 | 1 |

**Mussel Shell Development Test**

**ENVIRON**

### Combined Proportion Normal Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 269/269 | 261/261 | 257/257 |
| 0.014 | | 274/274 | 247/247 | 282/282 |
| 0.037 | | 265/265 | 248/248 | 205/234 |
| 0.058 | | 238/238 | 235/235 | 265/265 |
| 0.155 | | 252/252 | 257/257 | 269/269 |
| 0.267 | | 0/234 | 0/234 | 0/234 |
| 0.397 | | 0/234 | 0/234 | 0/234 |

### Proportion Normal Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 269/276 | 261/263 | 257/262 |
| 0.014 | | 274/281 | 247/255 | 282/286 |
| 0.037 | | 265/268 | 248/254 | 205/213 |
| 0.058 | | 238/239 | 235/237 | 265/266 |
| 0.155 | | 252/261 | 257/265 | 269/282 |
| 0.267 | | 0/264 | 0/266 | 0/269 |
| 0.397 | | 0/288 | 0/240 | 0/276 |

### Proportion Survived Binomials

| C-mg/L | Control Type | Rep 1 | Rep 2 | Rep 3 |
|---|---|---|---|---|
| 0 | Dilution Water | 234/234 | 234/234 | 234/234 |
| 0.014 | | 234/234 | 234/234 | 234/234 |
| 0.037 | | 234/234 | 234/234 | 213/234 |
| 0.058 | | 234/234 | 234/234 | 234/234 |
| 0.155 | | 234/234 | 234/234 | 234/234 |
| 0.267 | | 234/234 | 234/234 | 234/234 |
| 0.397 | | 234/234 | 234/234 | 234/234 |

# CETIS Test Data Worksheet

**Report Date:** 20 Dec-15 18:22 (p 1 of 1)
**Test Code:** 14-1153-0185/54223DC9

**Mussel Shell Development Test** — **ENVIRON**

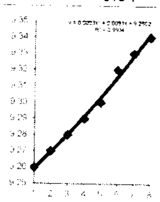
| | | | |
|---|---|---|---|
| **Start Date:** 07 Dec-15 18:00 | **Species:** Mytilus galloprovincialis | **Sample Code:** | 68B87A99 |
| **End Date:** 09 Dec-15 16:00 | **Protocol:** EPA/600/R-95/136 (1995) | **Sample Source:** | Reference Toxicant |
| **Sample Date:** 05 May-14 | **Material:** Unionized Ammonia | **Sample Station:** | p140505.220 |

| C-mg/L | Code | Rep | Pos | Initial Density | Final Density | # Counted | # Normal | Notes |
|---|---|---|---|---|---|---|---|---|
| 0 | D | 1 | 1 | 234 | 276 | 276 | 269 | |
| 0 | D | 2 | 2 | 234 | 263 | 263 | 261 | |
| 0 | D | 3 | 3 | 234 | 262 | 262 | 257 | |
| 0.014 | | 1 | 4 | 234 | 281 | 281 | 274 | |
| 0.014 | | 2 | 5 | 234 | 255 | 255 | 247 | |
| 0.014 | | 3 | 6 | 234 | 286 | 286 | 282 | |
| 0.037 | | 1 | 7 | 234 | 268 | 268 | 265 | |
| 0.037 | | 2 | 8 | 234 | 254 | 254 | 248 | |
| 0.037 | | 3 | 9 | 234 | 213 | 213 | 205 | |
| 0.058 | | 1 | 10 | 234 | 239 | 239 | 238 | |
| 0.058 | | 2 | 11 | 234 | 237 | 237 | 235 | |
| 0.058 | | 3 | 12 | 234 | 266 | 266 | 265 | |
| 0.155 | | 1 | 13 | 234 | 261 | 261 | 252 | |
| 0.155 | | 2 | 14 | 234 | 265 | 265 | 257 | |
| 0.155 | | 3 | 15 | 234 | 282 | 282 | 269 | |
| 0.267 | | 1 | 16 | 234 | 264 | 264 | 0 | |
| 0.267 | | 2 | 17 | 234 | 266 | 266 | 0 | |
| 0.267 | | 3 | 18 | 234 | 269 | 269 | 0 | |
| 0.397 | | 1 | 19 | 234 | 288 | 288 | 0 | |
| 0.397 | | 2 | 20 | 234 | 240 | 240 | 0 | |
| 0.397 | | 3 | 21 | 234 | 276 | 276 | 0 | |

| | | | |
|---|---|---|---|
| CLIENT: | GeoEngineers | Date of Test: | 07-Dec-15 |
| PROJECT: | RG Haley | Test Type: | Mytilus RT |
| COMMENTS: | P140505.220 | | |

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

| Integer: | I-factor |
|---|---|
| 1 | 9.26 |
| 2 | 9.27 |
| 3 | 9.28 |
| 4 | 9.29 |
| 5 | 9.30 |
| 6 | 9.32 |
| 7 | 9.33 |
| | 9.34 |



| | **Sample** | **Mod** | ***NH3T (mg/L)*** | ***salinity (ppt)*** | ***pH*** | ***temp (C)*** | temp (K) | i-factor | Mod | **NH3U (mg/L)** |
|---|---|---|---|---|---|---|---|---|---|---|
| | Target / Sample Name | | Actual | 22.9 | 8.0 | 24.1 | 297.26 | 9.3053 | | **#VALUE!** |
| | Example 3.5 | | 2.000 | 10.0 | 7.5 | 5.0 | 278.16 | 9.2750 | | **0.008** |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | 0.75 | | 0.583 | 28 | 8.0 | 16.2 | 289.36 | 9.3187 | | **0.014** |
| 5 | 1.5 | | 1.53 | 28 | 8.0 | 16.0 | 289.16 | 9.3187 | | **0.037** |
| 6 | 3 | | 2.38 | 28 | 8.0 | 16.1 | 289.26 | 9.3187 | | **0.058** |
| 7 | 6 | | 8.03 | 28 | 7.9 | 16.0 | 289.16 | 9.3187 | | **0.155** |
| 8 | 12 | | 14.1 | 28 | 7.9 | 15.7 | 288.86 | 9.3187 | | **0.267** |
| 9 | 18 | | 21.0 | 28 | 7.9 | 15.7 | 288.86 | 9.3187 | | **0.397** |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 36 | | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | | | | | | | | | | |

ENVIRON

| CLIENT | PROJECT | SPECIES | LAB / LOCATION | PROTOCOL |
|---|---|---|---|---|
| GeoEngineers | RG Haley | *Mytilus galloprovincialis* | Port Gamble / Incubator | PSEP (1995) |

| JOB NUMBER | PROJECT MANAGER | TEST START DATE: | TIME | TEST END DATE | TIME |
|---|---|---|---|---|---|
| 0 | B. Hester | 07Dec15 | 1800 | 09 Dec. 15 | 1600 |

| TEST ID | LOT #: |
|---|---|
| P140505.220 | 32446535 |

## WATER QUALITY DATA

| DILTIN.WAT.BATCH | ORGANISM BATCH | REFERENCE TOX. MATERIAL | REFERENCE TOXICANT |
|---|---|---|---|
| FSW120715.01 | | Ammonium chloride | Ammonia - TAN |

| CLIENT/ ID | CONCENTRATION | | DAY | REP | DO (mg/L) >5.0 D.O. meter | mg/L | TEMP(C) 16 ± 1 TEMP. meter | °C | SAL (ppt) 28 ± 1 SALINITY meter | ppt | pH 7 - 9 pH meter | unit | TECH. | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | value | units | | | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 7.9 | 8 | 16.5 | 8 | 28 | 8 | 8.0 | BH | 12.7 |
| | 0 | mg/L | 1 | Stock | 8 | 7.5 | 8 | 16.5 | 8 | 28 | 8 | 7.9 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.4 | 9 | 16.8 | 9 | 28 | 9 | 7.9 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.0 | 8 | 16.2 | 8 | 28 | 8 | 8.0 | BH | 12.7 |
| | 0.75 | mg/L | 1 | Stock | 8 | 7.8 | 8 | 16.5 | 8 | 28 | 8 | 8.0 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.6 | 9 | 16.7 | 9 | 28 | 9 | 8.0 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.0 | 8 | 16.0 | 8 | 28 | 8 | 8.0 | BH | 12.7 |
| | 1.5 | mg/L | 1 | Stock | 8 | 8.0 | 8 | 16.1 | 8 | 28 | 8 | 8.0 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.7 | 9 | 16.6 | 9 | 28 | 9 | 8.0 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.1 | 8 | 16.1 | 8 | 28 | 8 | 8.0 | BH | 12.7 |
| | 3 | mg/L | 1 | Stock | 8 | 8.0 | 8 | 16.0 | 8 | 28 | 8 | 8.0 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.8 | 9 | 16.0 | 9 | 28 | 9 | 8.0 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.1 | 8 | 16.0 | 8 | 28 | 8 | 7.9 | BH | 12.7 |
| | 6 | mg/L | 1 | Stock | 8 | 8.0 | 8 | 16.2 | 8 | 28 | 8 | 8.0 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.8 | 9 | 16.1 | 9 | 28 | 9 | 8.0 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.1 | 8 | 15.7 | 8 | 28 | 8 | 7.9 | BH | 12.7 |
| | 12 | mg/L | 1 | Stock | 8 | 8.0 | 8 | 15.9 | 8 | 28 | 8 | 7.9 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.8 | 9 | 16.1 | 9 | 28 | 9 | 7.9 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |
| Ref.Tox.-Ammonia - TAN | Target: | | 0 | Stock | 8 | 8.1 | 8 | 15.9 | 8 | 28 | 8 | 7.9 | BH | 12.7 |
| | 18 | mg/L | 1 | Stock | 8 | 7.9 | 8 | 15.8 | 8 | 28 | 8 | 7.9 | BE | 12/8 |
| | Actual: | | 2 | Stock | 9 | 7.7 | 9 | 15.5 | 9 | 28 | 9 | 7.9 | JL | 12/09 |
| | | | 3 | Stock | | | | | | | | | | |
| | | | 4 | Stock | | | | | | | | | | |

ENVIRON

| SPECIES | | | |
|---|---|---|---|
| *Mytilus galloprovincialis* | | | |

| CLIENT | PROJECT | JOB NUMBER | PROJECT MANAGER | LAB / LOCATION | PROTOCOL |
|---|---|---|---|---|---|
| GeoEngineers | RG Haley | 0 | B. Hester | Port Gamble / incubator | PSEP (1995) |

| TEST ID | ORGANISM BATCH | TEST START DATE: | TIME | TEST END DATE: | TIME |
|---|---|---|---|---|---|
| ① ~~PTS~~ P140505.220 | TS120415 | 07 DEC.15 | 1800 | 09 Dec.15 | 1600 |

## LARVAL OBSERVATION DATA

| CLIENT/ ID | CONC. value | CONC. units | VIAL NUMBER | REP | NUMBER NORMAL | NUMBER ABNORMAL | DATE | TECHNICIAN | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| Ref.Tox. - Ammonia - TAN | 0 | mg/L | | 1 | 269 | 7 | 12/17/15 | MARH | |
| | | | | 2 | 261 | 2 | | | |
| | | | | 3 | 257 | 5 | | | |
| Ref.Tox. - Ammonia - TAN | 0.75 | mg/L | | 1 | 274 | 7 | | | |
| | | | | 2 | 247 | 8 | | | |
| | | | | 3 | 282 | 4 | | | |
| Ref.Tox. - Ammonia - TAN | 1.5 | mg/L | | 1 | 265 | 3 | | | |
| | | | | 2 | 248 | 6 | | | |
| | | | | 3 | 205 | 8 | | | |
| Ref.Tox. - Ammonia - TAN | 3 | mg/L | | 1 | 238 | 1 | | | |
| | | | | 2 | 235 | 2 | | | |
| | | | | 3 | 265 | 1 | | | |
| Ref.Tox. - Ammonia - TAN | 6 | mg/L | | 1 | 252 | 9 | | | |
| | | | | 2 | 257 | 8 | | | |
| | | | | 3 | 269 | 13 | | | |
| Ref.Tox. - Ammonia - TAN | 12 | mg/L | | 1 | Ø | 264 | | | |
| | | | | 2 | Ø | 266 | | | |
| | | | | 3 | Ø | 269 | | | |
| Ref.Tox. - Ammonia - TAN | 18 | mg/L | | 1 | Ø | 288 | | | |
| | | | | 2 | Ø | 240 | | | |
| | | | | 3 | Ø | 276 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| STOCKING DENSITY | | 1 | | 245 | | | |
| | | 2 | | 267 | | | |
| | | 3 | | 189 | | | |

① ie-KMR. 12/7/15

mean: 234

ENVIRON **Ammonia Reference Toxicant Spiking Worksheet**

**Reference Toxicant ID:** P140505.220
**Date Prepared:** 12/7/15
**Technician Initials:** HE

# Biv / Echino $NH_3$ RT

Assumptions in Model
Stock ammonia concentration is 9,000 mg/L = 9 mg/mL

Date: 12/7/2015
Measurement: 9286.6

| Test Solutions | | | Volume of stock to reach desired concentration | |
|---|---|---|---|---|
| **Measured Concentration** | **Desired Concentration** | **Volume** | | |
| mg/L | mg/L | mL | mL stock to increase | |
| | | | [redacted] | SALT WATER |
| 0.583 | **0.75** | 250 | | **0.030** |
| 1.53 ~~2.04~~ ① | **1.5** | 250 | | **0.061** |
| 2.38 | **3** | 250 | | **0.121** |
| 8.03 | **6** | 250 | | **0.242** |
| 14.1 | **12** | 250 | | **0.485** |
| 21.0 | **18** | 250 | | **0.727** |
| | | | | |
| | | | | |

① TE HE 12/7

# APPENDIX B

# STATISTICAL COMPARISONS

Project Name: R. G. Haley - E. estuarius 10 day - Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 99 |
| SD: | 2.236 |
| Tr Mean: | 107.089 |
| Trans SD: | 16.776 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 95 |
| SD: | 3.536 |
| Tr Mean: | 83.479 |
| Trans SD: | 17.556 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 11.142 |
| SS: | 2358.564 |
| K: | 5 |
| b: | 46.701 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9247 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 12.004 |
| Test Residual SD: | 10.066 |
| Ref. Residual Mean: | 12.445 |
| Ref. Residual SD: | 10.705 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.0671 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -2.1742 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -30.01 |
| 2 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -11.914 |
| 3 | 100 | 114.592 | 90 | 71.565 | 7.503 | 11.914 | | | -6.4 |
| 4 | 95 | 77.079 | 100 | 114.592 | 30.01 | 31.113 | | | -6.4 |
| 5 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -6.4 |
| 6 | | | | | | | | | 7.503 |
| 7 | | | | | | | | | 7.503 |
| 8 | | | | | | | | | 7.503 |
| 9 | | | | | | | | | 7.503 |
| 10 | | | | | | | | | 31.113 |

Project Name: R. G. Haley - E. estuarius 10 day - Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 99 |
| SD: | 2.236 |
| Tr Mean: | 107.089 |
| Trans SD: | 16.776 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 95 |
| SD: | 3.536 |
| Tr Mean: | 83.479 |
| Trans SD: | 17.556 |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 11.142 |
| SS: | 2358.564 |
| K: | 5 |
| b: | 46.701 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9247 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 12.004 |
| Test Residual SD: | 10.066 |
| Ref. Residual Mean: | 12.445 |
| Ref. Residual SD: | 10.705 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.0671 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

**Test Results:**

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -2.1742 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -30.01 |
| 2 | 95 | 77.079 | 95 | 77.079 | 30.01 | 6.4 | | | -11.914 |
| 3 | 100 | 114.592 | 90 | 71.565 | 7.503 | 11.914 | | | -6.4 |
| 4 | 100 | 114.592 | 100 | 114.592 | 7.503 | 31.113 | | | -6.4 |
| 5 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -6.4 |
| 6 | | | | | | | | | 7.503 |
| 7 | | | | | | | | | 7.503 |
| 8 | | | | | | | | | 7.503 |
| 9 | | | | | | | | | 7.503 |
| 10 | | | | | | | | | 31.113 |

Project Name: R. G. Haley - E. estuarius 10 day - Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 99 |
| SD: | 2.236 |
| Tr Mean: | 107.089 |
| Trans SD: | 16.776 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 95 |
| SD: | 3.536 |
| Tr Mean: | 83.479 |
| Trans SD: | 17.556 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 11.142 |
| SS: | 2358.564 |
| K: | 5 |
| b: | 46.701 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9247 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 12.004 |
| Test Residual SD: | 10.066 |
| Ref. Residual Mean: | 12.445 |
| Ref. Residual SD: | 10.705 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.0671 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -2.1742 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 95 | 77.079 | 95 | 77.079 | 30.01 | 6.4 | | | -30.01 |
| 2 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -11.914 |
| 3 | 100 | 114.592 | 90 | 71.565 | 7.503 | 11.914 | | | -6.4 |
| 4 | 100 | 114.592 | 100 | 114.592 | 7.503 | 31.113 | | | -6.4 |
| 5 | 100 | 114.592 | 95 | 77.079 | 7.503 | 6.4 | | | -6.4 |
| 6 | | | | | | | | | 7.503 |
| 7 | | | | | | | | | 7.503 |
| 8 | | | | | | | | | 7.503 |
| 9 | | | | | | | | | 7.503 |
| 10 | | | | | | | | | 31.113 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG AFDW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.688 |
| SD: | 0.115 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.527 |
| SD: | 0.11 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.073 |
| SS: | 0.101 |
| K: | 5 |
| b: | 0.289 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8265 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | No |
| Override Option: | Not Invoked |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0.079 |
| Test Residual SD: | 0.074 |
| Ref. Residual Mean: | 0.075 |
| Ref. Residual SD: | 0.071 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.1014 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Mann-Whitney |
| Balanced Design: | Yes |
| Transformation: | rank-order |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Mann-Whitney N1: | 5 |
| Mann-Whitney N2: | 5 |
| Degrees of Freedom: | |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 4 |
| Critical Value: | >= 21.000 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.585 | 5 | 0.714 | 9 | 0.103 | 0.187 | 1 | | -0.103 |
| 2 | 0.703 | 8 | 0.496 | 3 | 0.015 | 0.031 | 2 | | -0.1 |
| 3 | 0.688 | 7 | 0.517 | 4 | 0 | 0.01 | 3 | | -0.096 |
| 4 | 0.87 | 10 | 0.483 | 2 | 0.182 | 0.044 | 4 | | -0.044 |
| 5 | 0.592 | 6 | 0.427 | 1 | 0.096 | 0.1 | 5 | | -0.031 |
| 6 | | | | | | | 6 | | -0.01 |
| 7 | | | | | | | 7 | | 0 |
| 8 | | | | | | | 8 | | 0.015 |
| 9 | | | | | | | 9 | | 0.182 |
| 10 | | | | | | | 10 | | 0.187 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG DW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.843 |
| SD: | 0.117 |
| Tr Mean: | 0.843 |
| Trans SD: | 0.117 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.694 |
| SD: | 0.108 |
| Tr Mean: | 0.694 |
| Trans SD: | 0.108 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.073 |
| SS: | 0.101 |
| K: | 5 |
| b: | 0.308 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.939 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0.092 |
| Test Residual SD: | 0.056 |
| Ref. Residual Mean: | 0.076 |
| Ref. Residual SD: | 0.067 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.4001 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -2.0943 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.696 | 0.696 | 0.884 | 0.884 | 0.147 | 0.19 | | | -0.147 |
| 2 | 0.909 | 0.909 | 0.621 | 0.621 | 0.066 | 0.073 | | | -0.082 |
| 3 | 0.86 | 0.86 | 0.67 | 0.67 | 0.017 | 0.024 | | | -0.073 |
| 4 | 0.989 | 0.989 | 0.63 | 0.63 | 0.146 | 0.064 | | | -0.064 |
| 5 | 0.761 | 0.761 | 0.665 | 0.665 | 0.082 | 0.029 | | | -0.029 |
| 6 | | | | | | | | | -0.024 |
| 7 | | | | | | | | | 0.017 |
| 8 | | | | | | | | | 0.066 |
| 9 | | | | | | | | | 0.146 |
| 10 | | | | | | | | | 0.19 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | N/A |
| Residual SD: | N/A |
| SS: | 0 |
| K: | 0 |
| b: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Normally Distributed: | N/A |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0 |
| Test Residual SD: | 0 |
| Ref. Residual Mean: | 0 |
| Ref. Residual SD: | 0 |
| Deg. of Freedom: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Variances Homogeneous: | N/A |

Test Results:

| | |
|---|---|
| Statistic: | 1-Sample t-Test |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 4 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 0 |
| Critical Value: | <= -2.132 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 2 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 3 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 4 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 5 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG AFDW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.631 |
| SD: | 0.09 |
| Tr Mean: | 0.631 |
| Trans SD: | 0.09 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.527 |
| SD: | 0.11 |
| Tr Mean: | 0.527 |
| Trans SD: | 0.11 |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.065 |
| SS: | 0.08 |
| K: | 5 |
| b: | 0.28 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9738 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 0.062 |
| Test Residual SD: | 0.058 |
| Ref. Residual Mean: | 0.075 |
| Ref. Residual SD: | 0.071 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.3179 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

**Test Results:**

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -1.6333 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.653 | 0.653 | 0.714 | 0.714 | 0.022 | 0.187 | | | -0.154 |
| 2 | 0.648 | 0.648 | 0.496 | 0.496 | 0.017 | 0.031 | | | -0.1 |
| 3 | 0.662 | 0.662 | 0.517 | 0.517 | 0.031 | 0.01 | | | -0.044 |
| 4 | 0.715 | 0.715 | 0.483 | 0.483 | 0.084 | 0.044 | | | -0.031 |
| 5 | 0.477 | 0.477 | 0.427 | 0.427 | 0.154 | 0.1 | | | -0.01 |
| 6 | | | | | | | | | 0.017 |
| 7 | | | | | | | | | 0.022 |
| 8 | | | | | | | | | 0.031 |
| 9 | | | | | | | | | 0.084 |
| 10 | | | | | | | | | 0.187 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG DW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.774 |
| SD: | 0.101 |
| Tr Mean: | 0.774 |
| Trans SD: | 0.101 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.694 |
| SD: | 0.108 |
| Tr Mean: | 0.694 |
| Trans SD: | 0.108 |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.068 |
| SS: | 0.088 |
| K: | 5 |
| b: | 0.289 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.957 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 0.072 |
| Test Residual SD: | 0.061 |
| Ref. Residual Mean: | 0.076 |
| Ref. Residual SD: | 0.067 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.1026 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

**Test Results:**

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -1.206 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.751 | 0.751 | 0.884 | 0.884 | 0.023 | 0.19 | | | -0.157 |
| 2 | 0.803 | 0.803 | 0.621 | 0.621 | 0.029 | 0.073 | | | -0.073 |
| 3 | 0.808 | 0.808 | 0.67 | 0.67 | 0.034 | 0.024 | | | -0.064 |
| 4 | 0.89 | 0.89 | 0.63 | 0.63 | 0.116 | 0.064 | | | -0.029 |
| 5 | 0.617 | 0.617 | 0.665 | 0.665 | 0.157 | 0.029 | | | -0.024 |
| 6 | | | | | | | | | -0.023 |
| 7 | | | | | | | | | 0.029 |
| 8 | | | | | | | | | 0.034 |
| 9 | | | | | | | | | 0.116 |
| 10 | | | | | | | | | 0.19 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | N/A |
| Residual SD: | N/A |
| SS: | 0 |
| K: | 0 |
| b: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Normally Distributed: | N/A |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0 |
| Test Residual SD: | 0 |
| Ref. Residual Mean: | 0 |
| Ref. Residual SD: | 0 |
| Deg. of Freedom: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Variances Homogeneous: | N/A |

Test Results:

| | |
|---|---|
| Statistic: | 1-Sample t-Test |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 4 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 0 |
| Critical Value: | <= -2.132 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 2 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 3 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 4 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 5 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG AFDW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.567 |
| SD: | 0.044 |
| Tr Mean: | 0.567 |
| Trans SD: | 0.044 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.527 |
| SD: | 0.11 |
| Tr Mean: | 0.527 |
| Trans SD: | 0.11 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.054 |
| SS: | 0.056 |
| K: | 5 |
| b: | 0.221 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8749 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0.035 |
| Test Residual SD: | 0.021 |
| Ref. Residual Mean: | 0.075 |
| Ref. Residual SD: | 0.071 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 1.2086 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -0.7579 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.569 | 0.569 | 0.714 | 0.714 | 0.002 | 0.187 | | | -0.1 |
| 2 | 0.537 | 0.537 | 0.496 | 0.496 | 0.03 | 0.031 | | | -0.056 |
| 3 | 0.61 | 0.61 | 0.517 | 0.517 | 0.043 | 0.01 | | | -0.044 |
| 4 | 0.61 | 0.61 | 0.483 | 0.483 | 0.043 | 0.044 | | | -0.031 |
| 5 | 0.511 | 0.511 | 0.427 | 0.427 | 0.056 | 0.1 | | | -0.03 |
| 6 | | | | | | | | | -0.01 |
| 7 | | | | | | | | | 0.002 |
| 8 | | | | | | | | | 0.043 |
| 9 | | | | | | | | | 0.043 |
| 10 | | | | | | | | | 0.187 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - MIG DW

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 0.679 |
| SD: | 0.064 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 0.694 |
| SD: | 0.108 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.058 |
| SS: | 0.063 |
| K: | 5 |
| b: | 0.229 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8292 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | No |
| Override Option: | Not Invoked |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0.053 |
| Test Residual SD: | 0.025 |
| Ref. Residual Mean: | 0.076 |
| Ref. Residual SD: | 0.067 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.7268 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Mann-Whitney |
| Balanced Design: | Yes |
| Transformation: | rank-order |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Mann-Whitney N1: | 5 |
| Mann-Whitney N2: | 5 |
| Degrees of Freedom: | |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 13 |
| Critical Value: | >= 21.000 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.668 | 6 | 0.884 | 10 | 0.011 | 0.19 | 1 | | -0.073 |
| 2 | 0.626 | 3 | 0.621 | 2 | 0.053 | 0.073 | 2 | | -0.069 |
| 3 | 0.738 | 8 | 0.67 | 7 | 0.059 | 0.024 | 3 | | -0.064 |
| 4 | 0.751 | 9 | 0.63 | 4 | 0.072 | 0.064 | 4 | | -0.053 |
| 5 | 0.61 | 1 | 0.665 | 5 | 0.069 | 0.029 | 5 | | -0.029 |
| 6 | | | | | | | 6 | | -0.024 |
| 7 | | | | | | | 7 | | -0.011 |
| 8 | | | | | | | 8 | | 0.059 |
| 9 | | | | | | | 9 | | 0.072 |
| 10 | | | | | | | 10 | | 0.19 |

Project Name: R. G. Haley - N. arenaceodentata 20 day - survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 100 |
| SD: | 0 |
| Tr Mean: | 114.592 |
| Trans SD: | 0 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | N/A |
| Residual SD: | N/A |
| SS: | 0 |
| K: | 0 |
| b: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Normally Distributed: | N/A |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 0 |
| Test Residual SD: | 0 |
| Ref. Residual Mean: | 0 |
| Ref. Residual SD: | 0 |
| Deg. of Freedom: | 0 |
| Alpha Level: | N/A |
| Calculated Value: | N/A |
| Critical Value: | N/A |
| Variances Homogeneous: | N/A |

Test Results:

| | |
|---|---|
| Statistic: | 1-Sample t-Test |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 4 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 0 |
| Critical Value: | <= -2.132 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 2 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 3 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 4 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 5 | 100 | 114.592 | 100 | 114.592 | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 83.8 |
| SD: | 11.925 |
| Tr Mean: | 73.804 |
| Trans SD: | 23.419 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 87.4 |
| SD: | 11.845 |
| Tr Mean: | 71.043 |
| Trans SD: | 10.524 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 11.781 |
| SS: | 2636.85 |
| K: | 5 |
| b: | 47.183 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8443 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 16.315 |
| Test Residual SD: | 14.687 |
| Ref. Residual Mean: | 9.097 |
| Ref. Residual SD: | 2.704 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 1.0807 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | -0.2404 |
| Critical Value: | >= 1.397 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 80 | 63.435 | 75 | 60 | 10.369 | 11.043 | | | -18.865 |
| 2 | 86 | 68.027 | 94 | 75.821 | 5.777 | 4.778 | | | -11.7 |
| 3 | 67 | 54.938 | 97 | 80.026 | 18.865 | 8.983 | | | -11.043 |
| 4 | 100 | 114.592 | 97 | 80.026 | 40.788 | 8.983 | | | -10.369 |
| 5 | 86 | 68.027 | 74 | 59.343 | 5.777 | 11.7 | | | -5.777 |
| 6 | | | | | | | | | -5.777 |
| 7 | | | | | | | | | 4.778 |
| 8 | | | | | | | | | 8.983 |
| 9 | | | | | | | | | 8.983 |
| 10 | | | | | | | | | 40.788 |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | | | |
|---|---|---|---|
| Sample: | x1 | Ref Samp: | x2 |
| Samp ID: | SS1-SS-03-0-12 | Ref ID: | CR22 |
| Alias: | Sample | Alias: | Reference |
| Replicates: | 5 | Replicates: | 5 |
| Mean: | 98.8 | Mean: | 98.4 |
| SD: | 0.837 | SD: | 0.548 |
| Tr Mean: | 98.8 | Tr Mean: | 98.4 |
| Trans SD: | 0.837 | Trans SD: | 0.548 |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.459 |
| SS: | 4 |
| K: | 5 |
| b: | 1.92 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9216 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 0.64 |
| Test Residual SD: | 0.434 |
| Ref. Residual Mean: | 0.48 |
| Ref. Residual SD: | 0.11 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.8 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

**Test Results:**

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | -0.8944 |
| Critical Value: | >= 1.397 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 99 | 99 | 98 | 98 | 0.2 | 0.4 | | | -0.8 |
| 2 | 98 | 98 | 98 | 98 | 0.8 | 0.4 | | | -0.8 |
| 3 | 98 | 98 | 99 | 99 | 0.8 | 0.6 | | | -0.4 |
| 4 | 100 | 100 | 98 | 98 | 1.2 | 0.4 | | | -0.4 |
| 5 | 99 | 99 | 99 | 99 | 0.2 | 0.6 | | | -0.4 |
| 6 | | | | | | | | | 0.2 |
| 7 | | | | | | | | | 0.2 |
| 8 | | | | | | | | | 0.6 |
| 9 | | | | | | | | | 0.6 |
| 10 | | | | | | | | | 1.2 |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 89.4 |
| SD: | 7.021 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 87.4 |
| SD: | 11.845 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 10.666 |
| SS: | 2161.49 |
| K: | 5 |
| b: | 41.355 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.7912 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | No |
| Override Option: | Not Invoked |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 14.625 |
| Test Residual SD: | 12.737 |
| Ref. Residual Mean: | 9.097 |
| Ref. Residual SD: | 2.704 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.9493 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Mann-Whitney |
| Balanced Design: | Yes |
| Transformation: | rank-order |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Mann-Whitney N1: | 5 |
| Mann-Whitney N2: | 5 |
| Degrees of Freedom: | |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | 12 |
| Critical Value: | >= 20.000 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 83 | 3 | 75 | 2 | 12.378 | 11.043 | 1 | | -12.378 |
| 2 | 93 | 6 | 94 | 7 | 3.37 | 4.778 | 2 | | -11.7 |
| 3 | 85 | 4 | 97 | 8.5 | 10.815 | 8.983 | 3 | | -11.043 |
| 4 | 86 | 5 | 97 | 8.5 | 10.001 | 8.983 | 4 | | -10.815 |
| 5 | 100 | 10 | 74 | 1 | 36.563 | 11.7 | 5 | | -10.001 |
| 6 | | | | | | | 6 | | -3.37 |
| 7 | | | | | | | 7 | | 4.778 |
| 8 | | | | | | | 8.5 | | 8.983 |
| 9 | | | | | | | 8.5 | | 8.983 |
| 10 | | | | | | | 10 | | 36.563 |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 99.2 |
| SD: | 0.447 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 98.4 |
| SD: | 0.548 |
| Tr Mean: | N/A |
| Trans SD: | N/A |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 0.324 |
| SS: | 2 |
| K: | 5 |
| b: | 1.232 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.7588 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | No |
| Override Option: | Not Invoked |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 0.32 |
| Test Residual SD: | 0.268 |
| Ref. Residual Mean: | 0.48 |
| Ref. Residual SD: | 0.11 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 1.2344 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

**Test Results:**

| | |
|---|---|
| Statistic: | Mann-Whitney |
| Balanced Design: | Yes |
| Transformation: | rank-order |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Mann-Whitney N1: | 5 |
| Mann-Whitney N2: | 5 |
| Degrees of Freedom: | |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | 4 |
| Critical Value: | >= 20.000 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 99 | 6.5 | 98 | 2 | 0.2 | 0.4 | 2 | | -0.4 |
| 2 | 99 | 6.5 | 98 | 2 | 0.2 | 0.4 | 2 | | -0.4 |
| 3 | 100 | 10 | 99 | 6.5 | 0.8 | 0.6 | 2 | | -0.4 |
| 4 | 99 | 6.5 | 98 | 2 | 0.2 | 0.4 | 6.5 | | -0.2 |
| 5 | 99 | 6.5 | 99 | 6.5 | 0.2 | 0.6 | 6.5 | | -0.2 |
| 6 | | | | | | | 6.5 | | -0.2 |
| 7 | | | | | | | 6.5 | | -0.2 |
| 8 | | | | | | | 6.5 | | 0.6 |
| 9 | | | | | | | 6.5 | | 0.6 |
| 10 | | | | | | | 10 | | 0.8 |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 99.2 |
| SD: | 0.837 |
| Tr Mean: | 95.915 |
| Trans SD: | 17.077 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 98.4 |
| SD: | 0.548 |
| Tr Mean: | 82.826 |
| Trans SD: | 1.31 |

**Shapiro-Wilk Results:**

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 7.859 |
| SS: | 1173.392 |
| K: | 5 |
| b: | 31.856 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8648 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

**Levene's Results:**

| | |
|---|---|
| Test Residual Mean: | 14.941 |
| Test Residual SD: | 3.547 |
| Ref. Residual Mean: | 1.148 |
| Ref. Residual SD: | 0.262 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 8.6725 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | No |

**Test Results:**

| | |
|---|---|
| Statistic: | Approximate t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 4 |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | -1.7088 |
| Critical Value: | >= 1.533 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 114.592 | 98 | 81.87 | 18.677 | 0.956 | | | -14.045 |
| 2 | 99 | 84.261 | 98 | 81.87 | 11.654 | 0.956 | | | -11.654 |
| 3 | 98 | 81.87 | 99 | 84.261 | 14.045 | 1.435 | | | -11.654 |
| 4 | 99 | 84.261 | 98 | 81.87 | 11.654 | 0.956 | | | -0.956 |
| 5 | 100 | 114.592 | 99 | 84.261 | 18.677 | 1.435 | | | -0.956 |
| 6 | | | | | | | | | -0.956 |
| 7 | | | | | | | | | 1.435 |
| 8 | | | | | | | | | 1.435 |
| 9 | | | | | | | | | 18.677 |
| 10 | | | | | | | | | 18.677 |

Project Name: R. G. Haley - M. Galloprovincialis 48 hr - Normalized Combined Survival

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 91.8 |
| SD: | 7.085 |
| Tr Mean: | 80.682 |
| Trans SD: | 19.876 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 87.4 |
| SD: | 11.845 |
| Tr Mean: | 71.043 |
| Trans SD: | 10.524 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 10.319 |
| SS: | 2023.308 |
| K: | 5 |
| b: | 41.518 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8519 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 14.039 |
| Test Residual SD: | 12.194 |
| Ref. Residual Mean: | 9.097 |
| Ref. Residual SD: | 2.704 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.8847 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | ArcSin |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.1 |
| Calculated Value: | -0.9583 |
| Critical Value: | >= 1.397 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 90 | 71.565 | 75 | 60 | 9.117 | 11.043 | | | -15.032 |
| 2 | 83 | 65.65 | 94 | 75.821 | 15.032 | 4.778 | | | -11.7 |
| 3 | 100 | 114.592 | 97 | 80.026 | 33.91 | 8.983 | | | -11.043 |
| 4 | 88 | 69.732 | 97 | 80.026 | 10.95 | 8.983 | | | -10.95 |
| 5 | 98 | 81.87 | 74 | 59.343 | 1.188 | 11.7 | | | -9.117 |
| 6 | | | | | | | | | 1.188 |
| 7 | | | | | | | | | 4.778 |
| 8 | | | | | | | | | 8.983 |
| 9 | | | | | | | | | 8.983 |
| 10 | | | | | | | | | 33.91 |

Project Name: R. G. Haley - M. gallo 48 hr percent normal

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-03-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 229.2 |
| SD: | 32.844 |
| Tr Mean: | 229.2 |
| Trans SD: | 32.844 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 238.8 |
| SD: | 32.019 |
| Tr Mean: | 238.8 |
| Trans SD: | 32.019 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 21.046 |
| SS: | 8415.6 |
| K: | 5 |
| b: | 89.139 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9442 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 22.56 |
| Test Residual SD: | 21.036 |
| Ref. Residual Mean: | 27.84 |
| Ref. Residual SD: | 7.508 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 0.5286 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | 0.468 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 219 | 219 | 206 | 206 | 10.2 | 32.8 | | | -46.2 |
| 2 | 234 | 234 | 256 | 256 | 4.8 | 17.2 | | | -36.8 |
| 3 | 183 | 183 | 266 | 266 | 46.2 | 27.2 | | | -32.8 |
| 4 | 274 | 274 | 264 | 264 | 44.8 | 25.2 | | | -10.2 |
| 5 | 236 | 236 | 202 | 202 | 6.8 | 36.8 | | | 4.8 |
| 6 | | | | | | | | | 6.8 |
| 7 | | | | | | | | | 17.2 |
| 8 | | | | | | | | | 25.2 |
| 9 | | | | | | | | | 27.2 |
| 10 | | | | | | | | | 44.8 |

Project Name: R. G. Haley - M. gallo 48 hr percent normal

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-05-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 244.6 |
| SD: | 20.695 |
| Tr Mean: | 244.6 |
| Trans SD: | 20.695 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 238.8 |
| SD: | 32.019 |
| Tr Mean: | 238.8 |
| Trans SD: | 32.019 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 17.493 |
| SS: | 5814 |
| K: | 5 |
| b: | 73.121 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.9196 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 16.32 |
| Test Residual SD: | 9.766 |
| Ref. Residual Mean: | 27.84 |
| Ref. Residual SD: | 7.508 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 2.0912 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | No |

Test Results:

| | |
|---|---|
| Statistic: | Approximate t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 7 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -0.3402 |
| Critical Value: | >= 1.895 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 226 | 226 | 206 | 206 | 18.6 | 32.8 | | | -36.8 |
| 2 | 253 | 253 | 256 | 256 | 8.4 | 17.2 | | | -32.8 |
| 3 | 233 | 233 | 266 | 266 | 11.6 | 27.2 | | | -18.6 |
| 4 | 234 | 234 | 264 | 264 | 10.6 | 25.2 | | | -11.6 |
| 5 | 277 | 277 | 202 | 202 | 32.4 | 36.8 | | | -10.6 |
| 6 | | | | | | | | | 8.4 |
| 7 | | | | | | | | | 17.2 |
| 8 | | | | | | | | | 25.2 |
| 9 | | | | | | | | | 27.2 |
| 10 | | | | | | | | | 32.4 |

Project Name: R. G. Haley - M. gallo 48 hr percent normal

| | |
|---|---|
| Sample: | x1 |
| Samp ID: | SS1-SS-06-0-12 |
| Alias: | Sample |
| Replicates: | 5 |
| Mean: | 254 |
| SD: | 24.485 |
| Tr Mean: | 254 |
| Trans SD: | 24.485 |

| | |
|---|---|
| Ref Samp: | x2 |
| Ref ID: | CR22 |
| Alias: | Reference |
| Replicates: | 5 |
| Mean: | 238.8 |
| SD: | 32.019 |
| Tr Mean: | 238.8 |
| Trans SD: | 32.019 |

Shapiro-Wilk Results:

| | |
|---|---|
| Residual Mean: | 0 |
| Residual SD: | 18.494 |
| SS: | 6498.8 |
| K: | 5 |
| b: | 76.382 |
| Alpha Level: | 0.05 |
| Calculated Value: | 0.8977 |
| Critical Value: | <= 0.842 |
| Normally Distributed: | Yes |
| Override Option: | N/A |

Levene's Results:

| | |
|---|---|
| Test Residual Mean: | 19.6 |
| Test Residual SD: | 10.922 |
| Ref. Residual Mean: | 27.84 |
| Ref. Residual SD: | 7.508 |
| Deg. of Freedom: | 8 |
| Alpha Level: | 0.1 |
| Calculated Value: | 1.3902 |
| Critical Value: | >= 1.860 |
| Variances Homogeneous: | Yes |

Test Results:

| | |
|---|---|
| Statistic: | Student's t |
| Balanced Design: | Yes |
| Transformation: | No Transformation |

Experimental Hypothesis

| | |
|---|---|
| Null: | x1 >= x2 |
| Alternate: | x1 < x2 |

| | |
|---|---|
| Degrees of Freedom: | 8 |
| Experimental Alpha Level: | 0.05 |
| Calculated Value: | -0.8432 |
| Critical Value: | >= 1.860 |
| Accept Null Hypothesis: | Yes |
| Power: | |
| Min. Difference for Power: | |

| Replicate Number | Test Data | Trans. Test Data | Reference Data | Trans. Reference Data | Levene's Test Residuals | Levene's Reference Residuals | Mann-Whitney Ranks | Rankits | Shipiro-Wilk Residuals |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 246 | 246 | 206 | 206 | 8 | 32.8 | | | -36.8 |
| 2 | 226 | 226 | 256 | 256 | 28 | 17.2 | | | -32.8 |
| 3 | 288 | 288 | 266 | 266 | 34 | 27.2 | | | -28 |
| 4 | 241 | 241 | 264 | 264 | 13 | 25.2 | | | -13 |
| 5 | 269 | 269 | 202 | 202 | 15 | 36.8 | | | -8 |
| 6 | | | | | | | | | 15 |
| 7 | | | | | | | | | 17.2 |
| 8 | | | | | | | | | 25.2 |
| 9 | | | | | | | | | 27.2 |
| 10 | | | | | | | | | 34 |

# APPENDIX C

# CHAIN-OF-CUSTODY FORMS

**CUSTODY TRANSFER**
**Printed: 12/03/15**
**ARI Job No: AOS3**

ANALYTICAL RESOURCES INCORPORATED
4611 South 134th Place, Suite [illegible]
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

| | | | |
|---|---|---|---|
| ARI Project Manager: Cheronne Oreiro | Client Contact: Dana Carlisle | Sampling Event: 0356-114-06 | Samples Received: 10/16/15 |
| | Client: GeoEngineers, Inc. | Project: R.G. Haley | Sample Site: NA |

| LOGNUM ARI ID | CLIENT ID | MATRIX | # CONTAINERS | ANALYTICAL REQUEST | ANALYTICAL REQUEST | ANALYTICAL REQUEST | COMMENTS |
|---|---|---|---|---|---|---|---|
| 15-19351 AOS3A | SSI-SS-03_0-12 | Sediment | 1 | Bioassay | | | |

UPS TRK #
1Z832 695 0355291547

| Comments/Special Instructions: | Relinquished By: | Received by: (Signature) | Relinquished By: | Received by: (Signature) |
|---|---|---|---|---|
| | Printed Name: Chris Atwell | Printed Name: Julia Leverfood | Printed Name: | Printed Name: |
| | Company: ARI | Company: Ramboll | Company: | Company: |
| | Date/Time: 12-3-15 1320 | Date/Time: 12/04/15 1515 | Date/Time: | Date/Time: |

**CUSTODY TRANSFER**
**Printed: 11/30/15**
**ARI Job No: AOL1**

ANALYTICAL RESOURCES INCORPORATED
4611 South 134th Place, Suite 100
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

| ARI Project Manager: Cheronne Oreiro | Client Contact: Dana Carlisle | Sampling Event: 0356-114-06 | Samples Received: 10/13/15 |
|---|---|---|---|
| | Client: GeoEngineers, Inc. | Project: R. G. Haley | Sample Site: NA |

| LOGNUM ARI ID | CLIENT ID | MATRIX | # CONTAINERS | ANALYTICAL REQUEST | ANALYTICAL REQUEST | ANALYTICAL REQUEST | COMMENTS |
|---|---|---|---|---|---|---|---|
| 15-18939 AOL1A | SSI-SS-05_0-12 | Sediment | 1 | Bioassay | | | |
| 15-18940 AOL1B | SSI-SS-06_0-12 | Sediment | 1 | Bioassay | | | |

Given to Environ per Nancy Musgrove

| Comments/Special Instructions: | Relinquished By: wl | Received by: (Signature) [signature] | Relinquished By: | Received by: (Signature) |
|---|---|---|---|---|
| | Printed Name: Emily Littman | Printed Name: Brian Hester | Printed Name: | Printed Name: |
| | Company: ARI | Company: Ramboll | Company: | Company: |
| | Date/Time: 11/30/15 1000 | Date/Time: 11.30.15 1000 | Date/Time: | Date/Time: |

**CUSTODY TRANSFER**
**Printed: 11/30/15**
**ARI Job No: AOS3**

ANALYTICAL RESOURCES INCORPORATED
4611 South 134th Place, Suite 100
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

| ARI Project Manager: Cheronne Oreiro | Client Contact: Dana Carlisle | Sampling Event: 0356-114-06 | Samples Received: 10/16/15 |
|---|---|---|---|
| | Client: GeoEngineers, Inc. | Project: R.G. Haley | Sample Site: NA |

| LOGNUM ARI ID | CLIENT ID | MATRIX | # CONTAINERS | ANALYTICAL REQUEST | ANALYTICAL REQUEST | ANALYTICAL REQUEST | COMMENTS |
|---|---|---|---|---|---|---|---|
| 15-19351 AOS3A | SSI-SS-03_0-12 | Sediment | 1 | Broassay | | | |

Given to Environ per Nancy Musgrove

| Comments/Special Instructions: | Relinquished By: | Received by: (Signature) | Relinquished By: | Received by: (Signature) |
|---|---|---|---|---|
| | Printed Name: Emily Litwin | Printed Name: Brian Hester | Printed Name: | Printed Name: |
| | Company: ARI | Company: Ramboll | Company: | Company: |
| | Date/Time: 11/30/15 1000 | Date/Time: 11.30.15 1000 | Date/Time: | Date/Time: |

# CHAIN OF CUSTODY

ENVIRON

Shipping: 4770 NE View Dr. Mail: P.O. Box 216
Port Gamble, WA. 98364
Tel: (360) 297-6045, Fax: (360)297-6901

| | | | |
|---|---|---|---|
| Destination: Ramboll | Sample Originator (Organization): Ramboll | Report Results To: | Phone: |
| Destination Contact: Brian Hester | PERSON WHO COLLECTED SAMPLE: Brian Hester | Contact Name: | Fax: |
| Date: 12.4.15 | Address: | Address: | Email: |
| Turn-Around-Time: | | | |
| Project Name: RG Haley | Phone: | Invoicing To: | |
| | Fax: | Comments or Special Instructions: | |
| Contract/PO: | E-mail: | | |

| No. | Sample ID | Matrix | Volume & Type of Container | Date & Time | Analyses: Ref Sed | | | | | | Preservation | Sample Temp Upon Receipt | LAB ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CR-22 | Sed | 3gall/bag | 12.4.15 | X | | | | | | 4°C | | |
| 2 | | | | | | | | | | | | | |
| 3 | 24 % fines | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |

| Relinquished by: | Recieved by: | Relinquished by: | Recieved by: | Matrix Codes: |
|---|---|---|---|---|
| Print Name: Brian Hester | Print Name: Jay Ward | Print Name: | Print Name: | FW = Fresh Water |
| Signature: [signature] | Signature: Jay Ward | Signature: | Signature: | SB = Salt & Brackish Water |
| Affiliation: Ramboll | Affiliation: Ramboll | Affiliation: | Affiliation: | SS = Soil & Sediment |
| Date/Time: 12.4.15 1400 | Date/Time: 12/4/15 1400 | Date/Time: | Date/Time: | |

## [illegible] of Custody Record & Laboratory Analysis Request

| | | | |
|---|---|---|---|
| [illegible] Assigned Number: | Turn-around Requested: | Page: 1 of 1 | |
| ARI Client Company: GEI | Phone: 206 818 8646 | Date: 10/12/15 | Ice Present? |
| Client Contact: Dana Cautrill / Nancy Musgrove | | No. of Coolers: | Cooler Temps: |
| Client Project Name: R.G. Haley | | | |
| Client Project #: 0356-114-06 | Samplers: GL/FB/CV | | |


**Analytical Resources, Incorporated**
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com


| Sample ID | Date | Time | Matrix | No. Containers | TOC | TS | Dx w/silica gel | SVOCs | Grain size | PAHs/ | Hold for potential analysis | D/F 1613 | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSI-SS-05 | 10/12/15 | 12:00 | Sed | ~~4~~ 5 | X | X | X | X | X | | | | |
| SSI-SS-06 | 10/12/15 | 12:36 | | 5 | X | X | No | X | X | | | | Hold for potential Dx |
| SSI-SS-07 | 10/12/15 | 13:05 | | 5 | X | X | X | X | X | | | | |
| SSI-SS-08 | 10/12/15 | 13:50 | | 2 | X | X | | | X | | | | |
| SSI-SS-09 | 10/12/15 | 14:10 | | 3 | X | X | | | X | X | | | |
| SSI-SS-10 | 10/12/15 | 14:35 | | 3 | X | X | | | X | X | | | |
| SSI-SS-11 | 10/12/15 | 15:40 | | 3 | X | X | | | X | X | | | |
| SSI-SS-12 | 10/12/15 | 16:00 | | 3 | X | X | | | X | X | | | |
| SSI-SS-13 | 10/12/15 | ~~14~~ 16:30 | | 2 | | | | | | | X | | |
| SSI-SS-DUP-01 | 10/12/15 | — | Sed | 2 | | | | | | | X | | |
| Rinsate-121012 | 10/12/15 | 1720 | W | ~~4~~ 6 | | | X | X | | | | X | |

Comments/Special Instructions

| Relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| (Signature) [signature] | (Signature) [signature] | (Signature) | (Signature) |
| Printed Name: Claudia De La Vía | Printed Name: YARED LISANWORK | Printed Name: | Printed Name: |
| Company: GeoEngineers | Company: YC #328 | Company: | Company: |
| Date & Time: 10/13/15 8:10AM | Date & Time: 10/13/15 8:10AM | Date & Time: | Date & Time: |

# ody Record & Laboratory Analysis Request

**Analytical Resources, Incorporated**
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com

| | | | |
|---|---|---|---|
| Number: | Turn-around Requested: Standard | Page: 1 of 1 | |
| Client Company: GeoEngineers | Phone: 206-239-3221 | Date: 10/15/15 | Ice Present? |
| Client Contact: Nancy Musgrave | | No. of Coolers: | Cooler Temps: |
| Client Project Name: R.G. Haley | | | |
| Client Project #: 0356-114-06 | Samplers: PRD/CVD | | |

| Sample ID | Date | Time | Matrix | No. Containers | TOC/Total Solids | Grain Size | Dx w/ silica gel | SMS SVOCs + SIM SVOCs | SIM PAHs | PCP (8041) | Dioxin/Furans | Bioassay Hold | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SS1-SS-03_0-12 | 10/15 | 1205 | Sed | 5 | X | X | X | X | | | | X | |
| SS1-SS-01_0-12 | ↓ | 1315 | ↓ | 5 | X | X | | X | | | | X | TPH for archive |
| SS1-SS-DUP-03 | ↓ | — | ↓ | 4 | X | X | | X | | | | | TPH for archive |
| Rinsate-151015 | 10/15 | 1535 | Water | 6 | | | X | X | | | X | | |
| SS1-SC-04_0-2 | | 1455 | Sed | 4 | X | X | X | | X | X | | | |
| SS1-SC-04_2-4 | | 1500 | | 5 | X | X | X | | X | X | | | |
| SS1-SC-DUP-03 | ↓ | — | ↓ | 4 | X | X | X | | X | X | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

| Comments/Special Instructions | Relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|---|
| | (Signature) [signature] | (Signature) [signature] | (Signature) | (Signature) |
| | Printed Name: Claudia De la Via | Printed Name: Brian Warren | Printed Name: | Printed Name: |
| | Company: GeoEngineers | Company: ARI | Company: | Company: |
| | Date & Time: 10/16/2015 8AM | Date & Time: 10/16/15 0800 | Date & Time: | Date & Time: |

*__Limits of Liability:__ ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

## [illegible] of Custody Record & Laboratory Analysis Request

| | |
|---|---|
| [illegible] Assigned Number: | Turn-around Requested: |
| ARI Client Company: GEI | Phone: 206 818 8646 |
| Client Contact: Dana Cannon / Nancy Musgrove | |
| Client Project Name: R.G. Haley | |
| Client Project #: 0356-114-06 | Samplers: GL/FB/CV |

| | |
|---|---|
| Page: 1 | of 1 |
| Date: 10/12/15 | Ice Present? |
| No. of Coolers: | Cooler Temps: |


**Analytical Resources, Incorporated**
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com


| Sample ID | Date | Time | Matrix | No. Containers | TOC | TS | Dx w/silica gel | SVOCs | Grain Size | PAHs/ | Hold for potential analysis | D/F 1613 | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSI-SS-05 | 10/12/15 | 12:00 | Sed | ~~4~~ 5 | X | X | X | X | X | | | | |
| SSI-SS-06 | 10/12/15 | 12:36 | | 5 | X | X | No | X | X | | | | Hold for potential Dx |
| SSI-SS-07 | 10/12/15 | 13:05 | | 5 | X | X | X | X | X | | | | |
| SSI-SS-08 | 10/12/15 | 13:50 | | 2 | X | X | | | X | | | | |
| SSI-SS-09 | 10/12/15 | 14:10 | | 3 | X | X | | | X | X | | | |
| SSI-SS-10 | 10/12/15 | 14:35 | | 3 | X | X | | | X | X | | | |
| SSI-SS-11 | 10/12/15 | 15:40 | | 3 | X | X | | | X | X | | | |
| SSI-SS-12 | 10/12/15 | 16:00 | | 3 | X | X | | | X | X | | | |
| SSI-SS-13 | 10/12/15 | ~~14~~ 16:30 | | 2 | | | | | | | X | | |
| SSI-SS-DUP-01 | 10/12/15 | — | Sed | 2 | | | | | | | X | | |
| Rinsate-131012 | 10/12/15 | 1720 | W | ~~4~~ 6 | | | X | X | | | | X | |

| Comments/Special Instructions | Relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|---|
| | (Signature) [signature] | (Signature) [signature] | (Signature) | (Signature) |
| | Printed Name: Claudia De La Via | Printed Name: YARED LISANWORK | Printed Name: | Printed Name: |
| | Company: GeoEngineers | Company: YL #328 | Company: | Company: |
| | Date & Time: 10/13/15 8:10AM | Date & Time: 10/13/15 8:10AM | Date & Time: | Date & Time: |

## ...ody Record & Laboratory Analysis Request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Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com


| | | | |
|---|---|---|---|
| ...Number: | Turn-around Requested: Standard | Page: 1 | of 1 |
| ...Client Company: GeoEngineers | Phone: 206-239-3221 | Date: 10/15/15 | Ice Present? |
| Client Contact: Nancy Musgrave | | No. of Coolers: | Cooler Temps: |
| Client Project Name: R.G. Haley | | | |
| Client Project #: 0356-114-06 | Samplers: PRD/CVD | | |

| Sample ID | Date | Time | Matrix | No. Containers | TOC/Total Solids | Grain Size | Dx w/ silica gel | SMS SVOCs + SIM SVOCs | SIM PAHs | PCP (8041) | Dioxin/Furans | Bioassay Hold | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSI-SS-03_0-12 | 10/15 | 1205 | Sed | 5 | X | X | X | X | | | | X | |
| SSI-SS-01_0-12 | ↓ | 1315 | ↓ | 5 | X | X | | X | | | | X | TPH for archive |
| SSI-SS-DUP-03 | ↓ | — | ↓ | 4 | X | X | | X | | | | | TPH for archive |
| Rinsate-151015 | 10/15 | 1535 | Water | 6 | | | X | X | | | X | | |
| SSI-SC-04_0-2 | | 1455 | Sed | 4 | X | X | X | | X | X | | | |
| SSI-SC-04_2-4 | | 1500 | | 5 | X | X | X | | X | X | | | |
| SSI-SC-DUP-03 | ↓ | — | ↓ | 4 | X | X | X | | X | X | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

| Comments/Special Instructions | Relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|---|
| | (Signature) [signature] | (Signature) [signature] | (Signature) | (Signature) |
| | Printed Name: Claudia De la Via | Printed Name: Brian Warren | Printed Name: | Printed Name: |
| | Company: GeoEngineers | Company: ARI | Company: | Company: |
| | Date & Time: 10/16/2015 8AM | Date & Time: 10/16/15 0800 | Date & Time: | Date & Time: |

*__Limits of Liability:__ ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

| | |
|---|---|
| **From:** | Nancy A. Musgrove |
| **To:** | Brian Hester |
| **Subject:** | RE: RG Haley bioassays |
| **Date:** | Wednesday, December 30, 2015 1:11:12 PM |
| **Attachments:** | image001.png |

Hi there

SS-03 = 25.6% fines

SS-05 = 18.8 %

SS-06 = 28.0 %

Thanks!!

**Nancy A. Musgrove**
**Environmental Scientist | GeoEngineers, Inc.**
**Telephone:** 206.239.3221
**Fax:** 206.728.2732
**Mobile:** 206.818.8646
**Email:** nmusgrove@geoengineers.com

**From:** Brian Hester [mailto:BHester@ramboll.com]
**Sent:** Wednesday, December 30, 2015 12:59 PM
**To:** Nancy A. Musgrove <nmusgrove@geoengineers.com>
**Cc:** Jay Word <JDWord@ramboll.com>
**Subject:** RE: RG Haley bioassays

Nancy,

I hope you had a good Holiday.

All tests for RG Haley are complete. The three samples do not appear to exceed SMS or DMMP criteria. We are working through a draft report now.

We had a quick question on the grain sizes for the samples. Do the %fines you provided earlier (email below) correspond to samples 3, 5, and 6, respectively. If not, what % fines correspond to which samples.

Thanks,

Brian

**Brian Hester**
Laboratory Director

D +1 360 297 6045
M +1 360 461 5784
BHester@ramboll.com

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Ramboll Environ: Port Gamble Environmental Laboratory
4770 NE View Drive
PO Box 216
Port Gamble, WA 98364
USA
www.ramboll-environ.com

RAMBOLL ENVIRON

---

**From:** Nancy A. Musgrove [mailto:nmusgrove@geoengineers.com]
**Sent:** Wednesday, November 25, 2015 8:55 AM
**To:** Brian Hester
**Subject:** RG Haley bioassays

Hi Brian

We finally got approval/input from Ecology on what samples they want tested for toxicity at the RG Haley site. We will be sending you three sediment samples to be tested using UV protocol; I will arrange for shipment with Cheronne today. Please let me know when you would be able to accept a shipment (I am assuming the lab is closed tomorrow). With respect to a reference sample—grain sizes for the three samples are 18.8%, 25.6%, and 28% fines. Give me a buzz if you have any questions.

Regards

--NAM

*Nancy A. Musgrove*
**Environmental Scientist | GeoEngineers, Inc.**
**Telephone:** 206.239.3221
**Fax:** 206.728.2732
**Mobile:** 206.818.8646
**Email:** nmusgrove@geoengineers.com

600 Stewart Street, Suite 1700
Seattle, WA 98101
www.geoengineers.com

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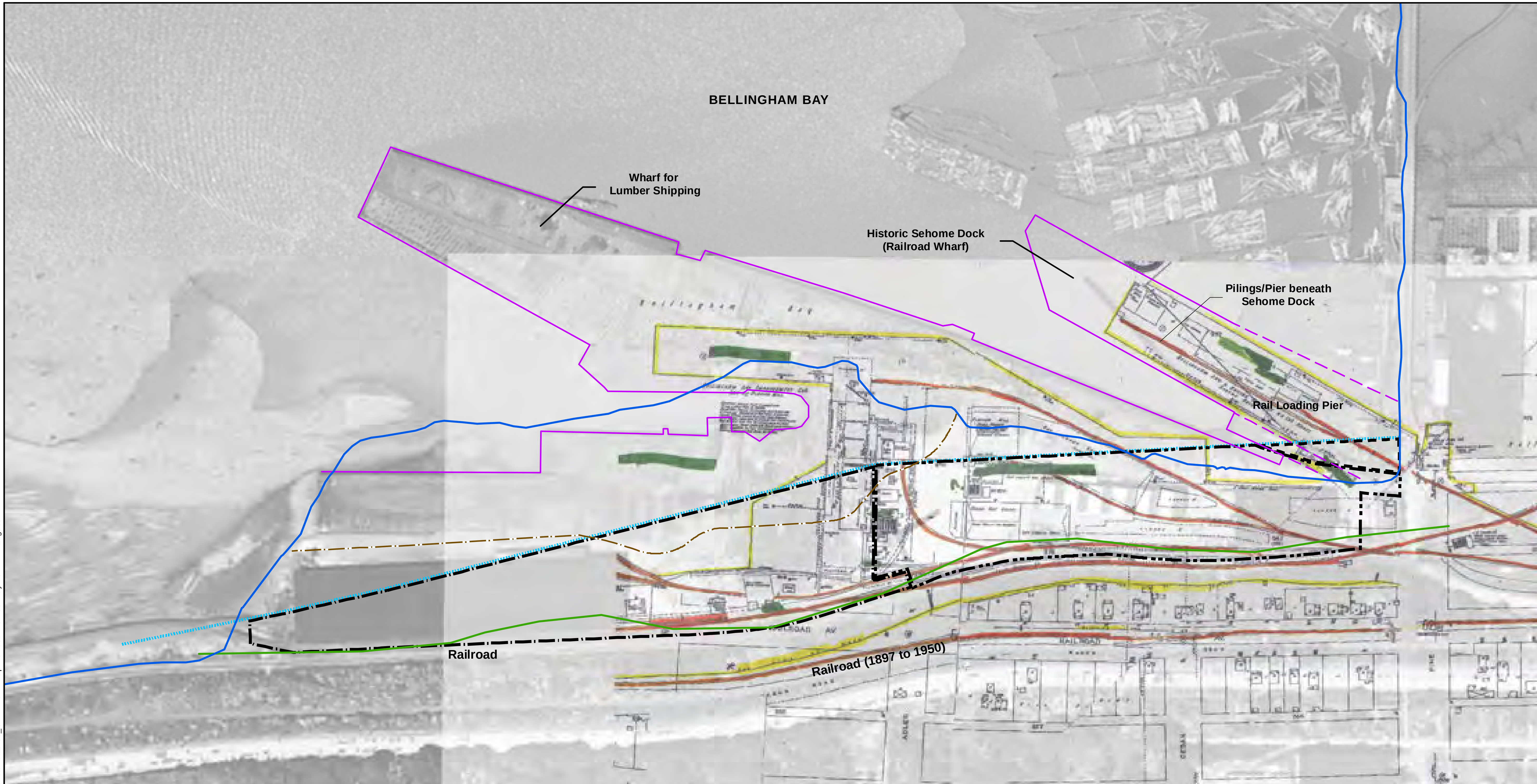
# APPENDIX F
## Historical Maps and Photos




0 200 400
Feet

W S N E True North Project North

**Legend**

- City-Owned Property, Former R.G. Haley International
- Cornwall Property
- Port of Bellingham Property
- Inner Harbor Line
- Footprint of Historic Over-Water Wharf or Pier
- Current Shoreline
- 1887 Shoreline
- Cornwall Approximate Landward Boundary of Landfill Refuse (Post Lumber Mill)

Reference: Walker and Associates photograph, 1950. Sanborn Maps, 1904.

Notes:
1. Extent of Cornwall Landfill refuse approximated from Figure 2-1 of Ecology Review Draft, Cornwall Avenue Landfill Remedial Investigation/Feasibility Study, Bellingham WA, Landau Associates Inc, 2013.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

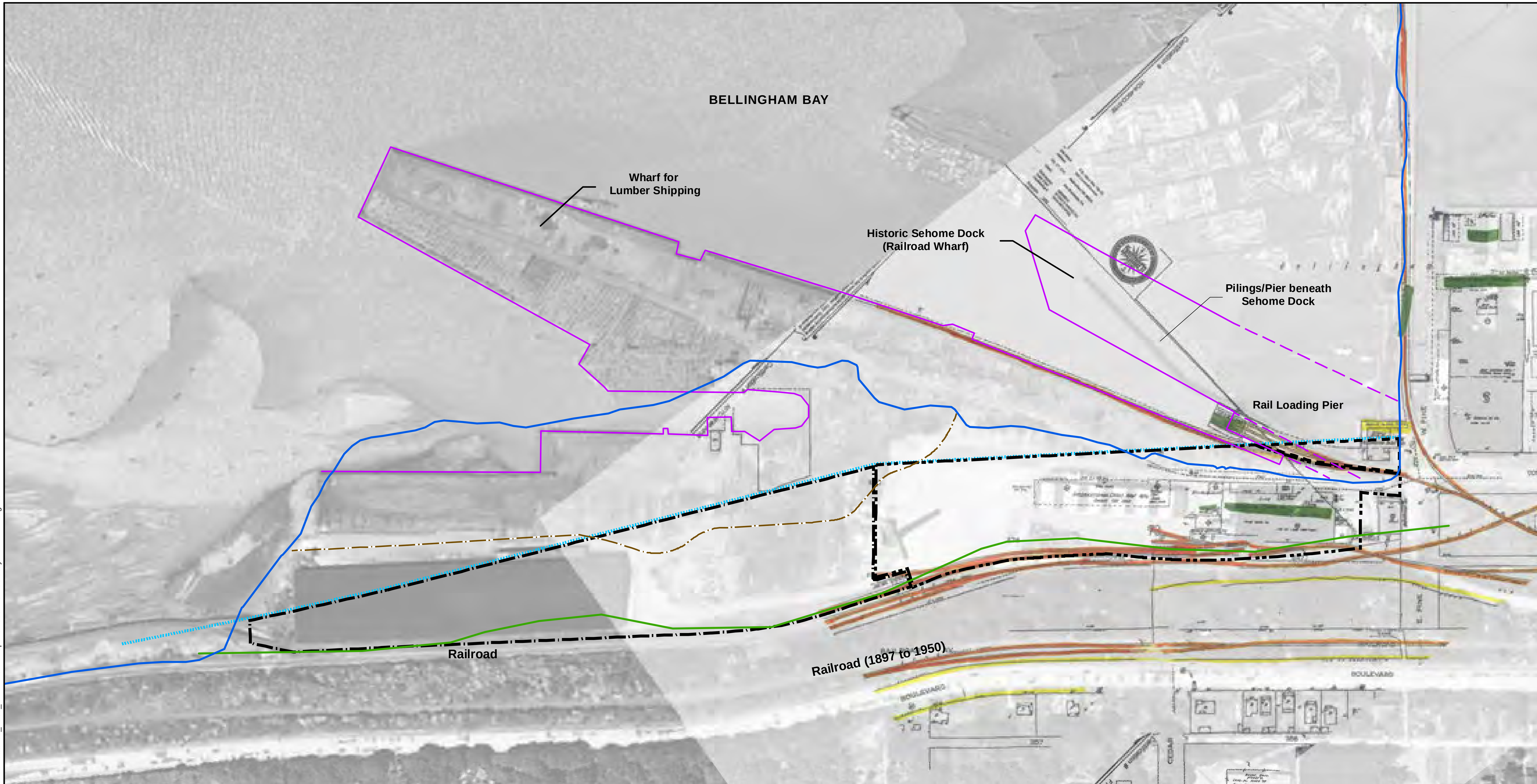
Path: \\seap2\projects\0\0356114\GIS\MXDs\Fig_2-3_HistoricalFeatures_CAP.mxd Map Revised: 16 February 2017 maugust

**Historical Over-Water Structures**
**1904 Sanborn Overlay**

R.G. Haley Site
Bellingham, Washington

GeoEngineers

**Figure F-1**




Legend

- City-Owned Property, Former R.G. Haley International
- Cornwall Property
- Port of Bellingham Property
- Inner Harbor Line
- Footprint of Historic Over-Water Wharf or Pier
- Current Shoreline
- 1887 Shoreline
- Cornwall Approximate Landward Boundary of Landfill Refuse (Post Lumber Mill)

True North
Project North

0 200 400
Feet

Reference: Walker and Associates photograph, 1950. Sanborn Maps, 1904.

Notes:
1. Extent of Cornwall Landfill refuse approximated from Figure 2-1 of Ecology Review Draft, Cornwall Avenue Landfill Remedial Investigation/Feasibility Study, Bellingham WA, Landau Associates Inc, 2013.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

**Historical Over-Water Structures**
**1950 Sanborn Overlay**

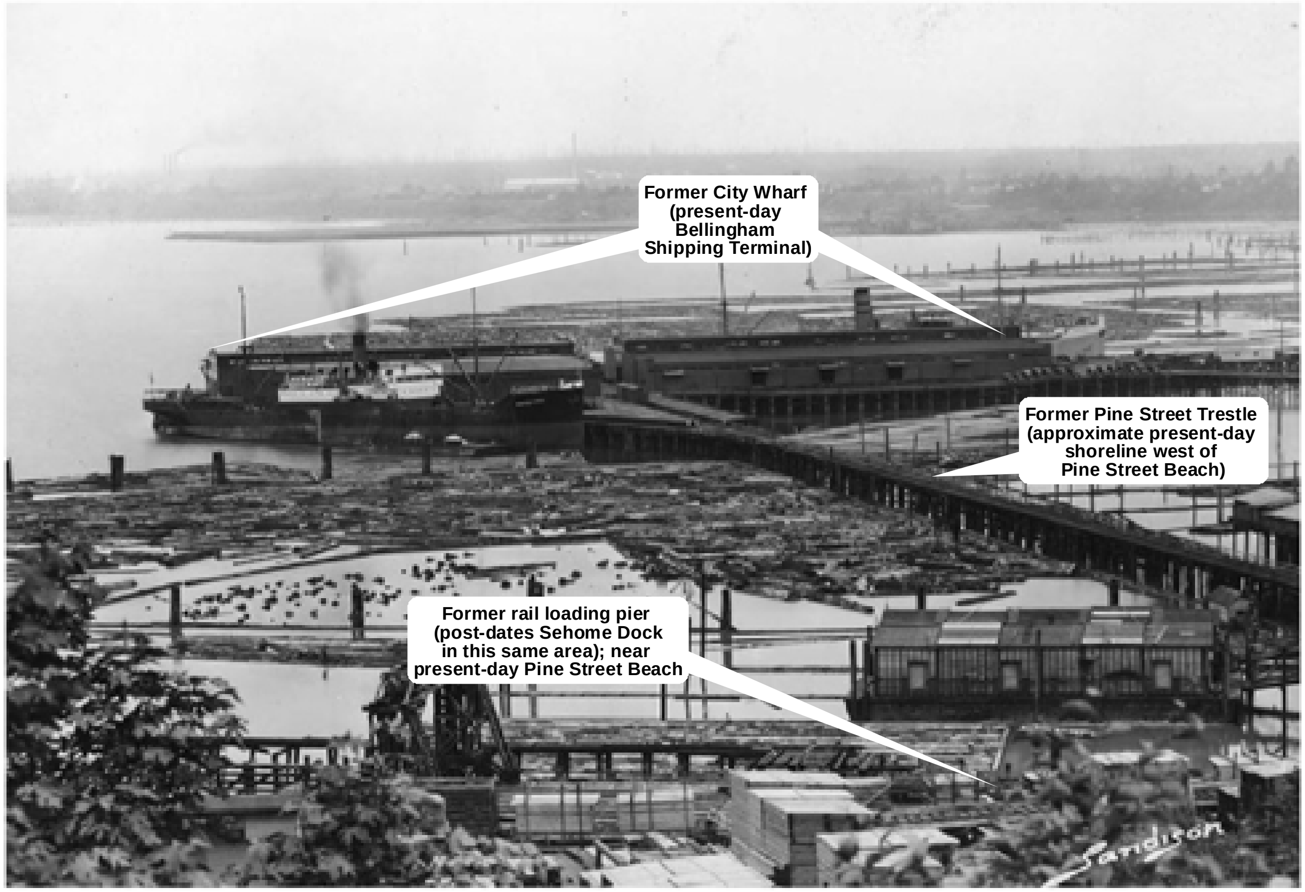
R.G. Haley Site
Bellingham, Washington

GeoEngineers

**Figure F-2**

Path: \\seap2\Projects\0\0356114\GIS\MXDs\Fig_2-3_HistoricalFeatures_1950_CAP.mxd Map Revised: 16 February 2017 maugust

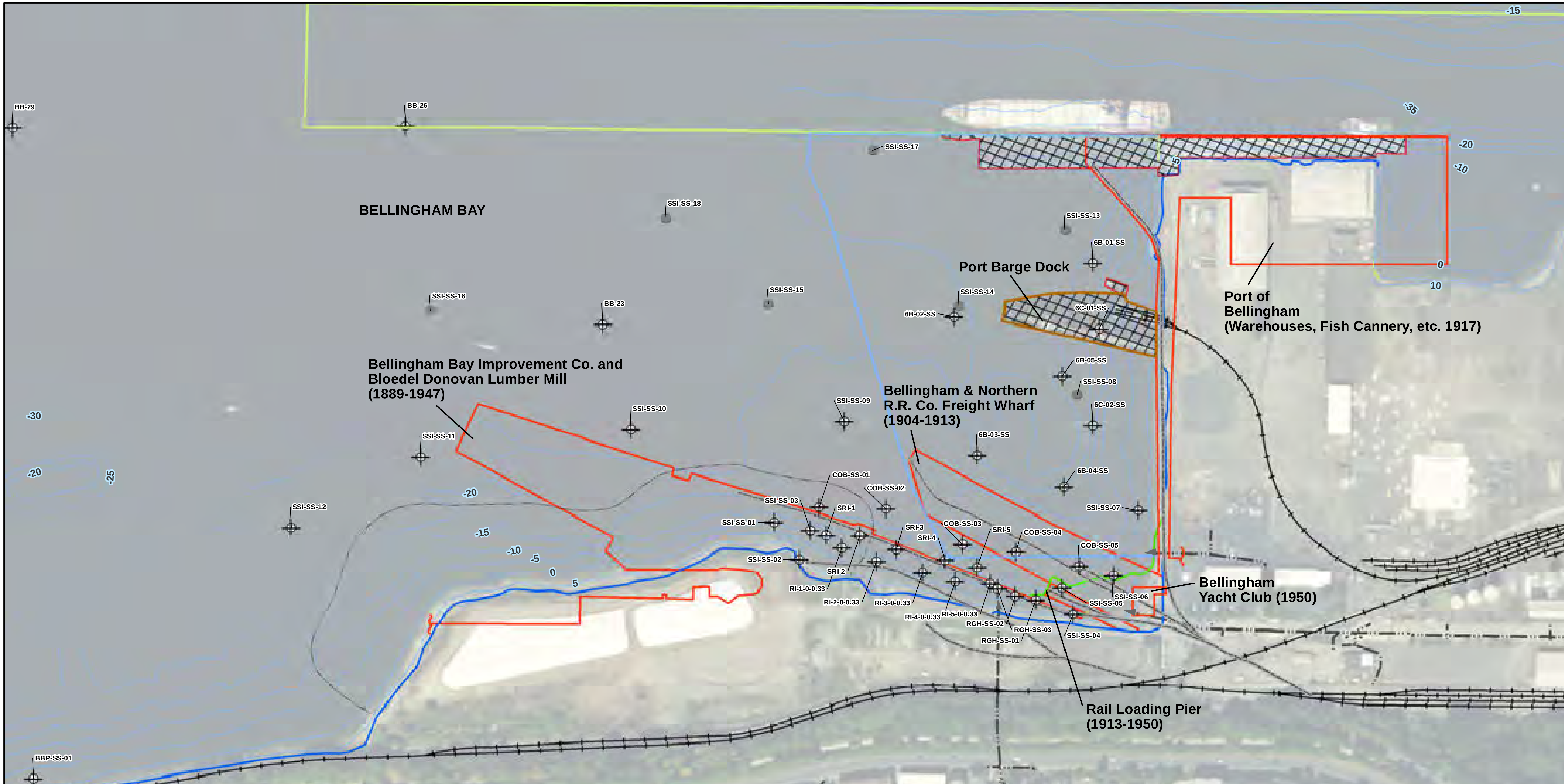
1930




Data Source: Western Washington University - Center for Pacific NW Studies (Galen Biery Collection #1196). Port of Bellingham (P-BBN-0353)

P:\0\0356114\GIS\MXDs\035611406_Fig_F03_HistPhoto_CAP.mxd Date Exported: 02/15/17 by maugust

| Historic Over-Water Structures (circa 1930) | |
|---|---|
| R.G. Haley Site<br>Bellingham, Washington | |
| GeoEngineers | Figure F-3 |




True North
Project North
0 150 300
Feet

Reference: Aerial from Google Earth, August 2011.
Contour elevation displayed is referenced to NAVD88 vertical datum.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Historical overwater structures in the Site area are shown in Figure 2-3 of Draft RI Report

Sediment Sample
Archived Sample

**Current**
- Storm Drain Pipe
- BNSF Railroad
- Present-day Over-water Structure
- Current Shoreline
- Contour (5-ft interval)

**Historic**
- Footprint of Historical Over-water Structure (Maximum Composite Footprint Over Years Shown)
- Former Railroad Tracks (G.N.R.R., G.M. & S.P., B.B. & B.C.)
- Apparent intertidal/subtidal fill (1950 aerial photo)

**Proposed Remedies**
- Proposed Cornwall Thin-Layer Cap
- Whatcom Waterway MNR Sediment Site Units
- Whatcom Waterway Dredging or Capping Site Units
- Whatcom Waterway Capping w/Armoring

**Historical Nearshore and Over-water Features**

R.G. Haley Site
Bellingham, Washington

GEOENGINEERS

Figure F-4

Path: P:\00356114\GIS\MXD\035611406_cPAH_HeatMaps_potential_sources_F-4.mxd Map Revised: 12 May 2017 maugust

# APPENDIX G
## PAH Profiles

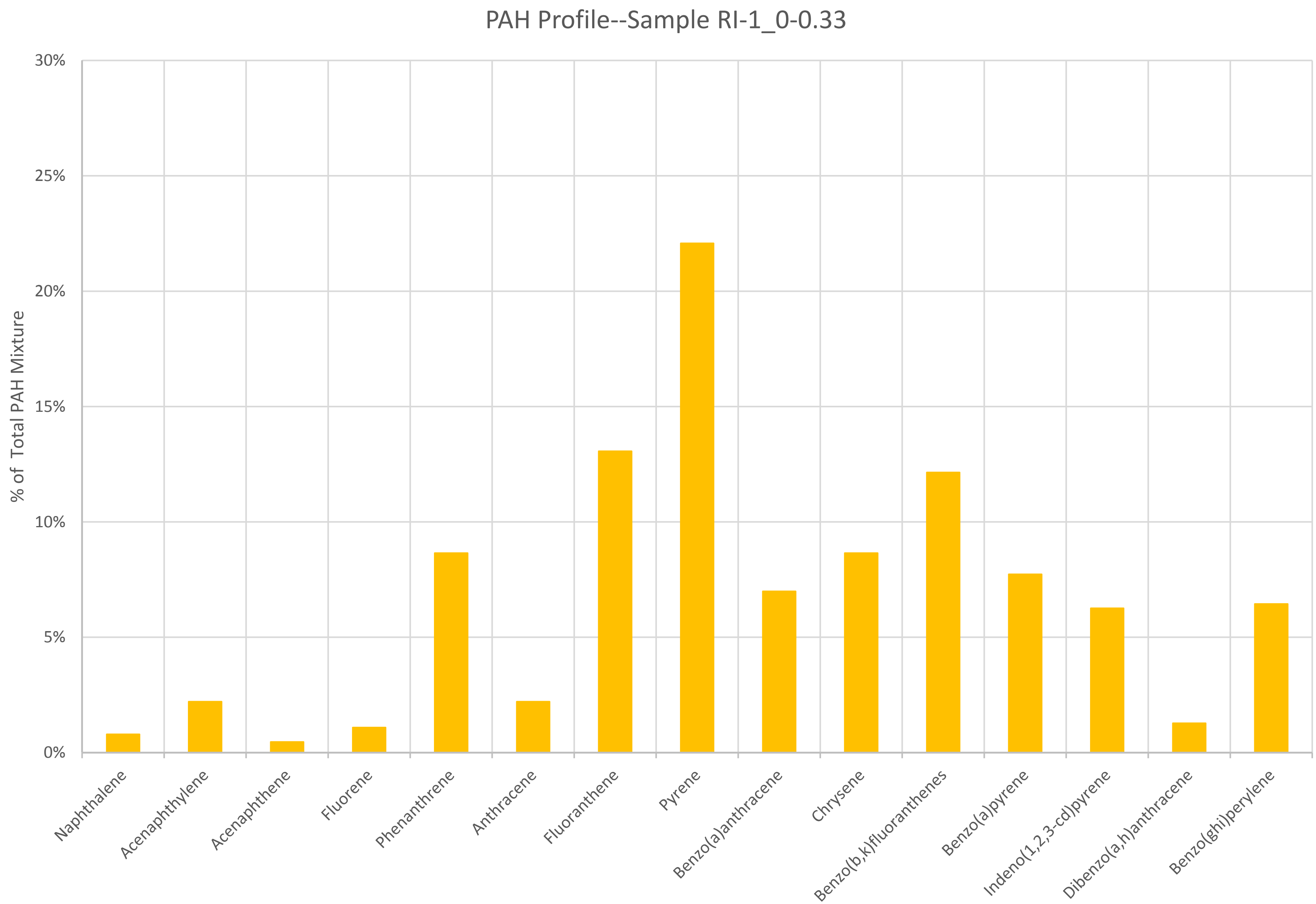

PAH Profile--Sample RI-1_0-0.33
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-1

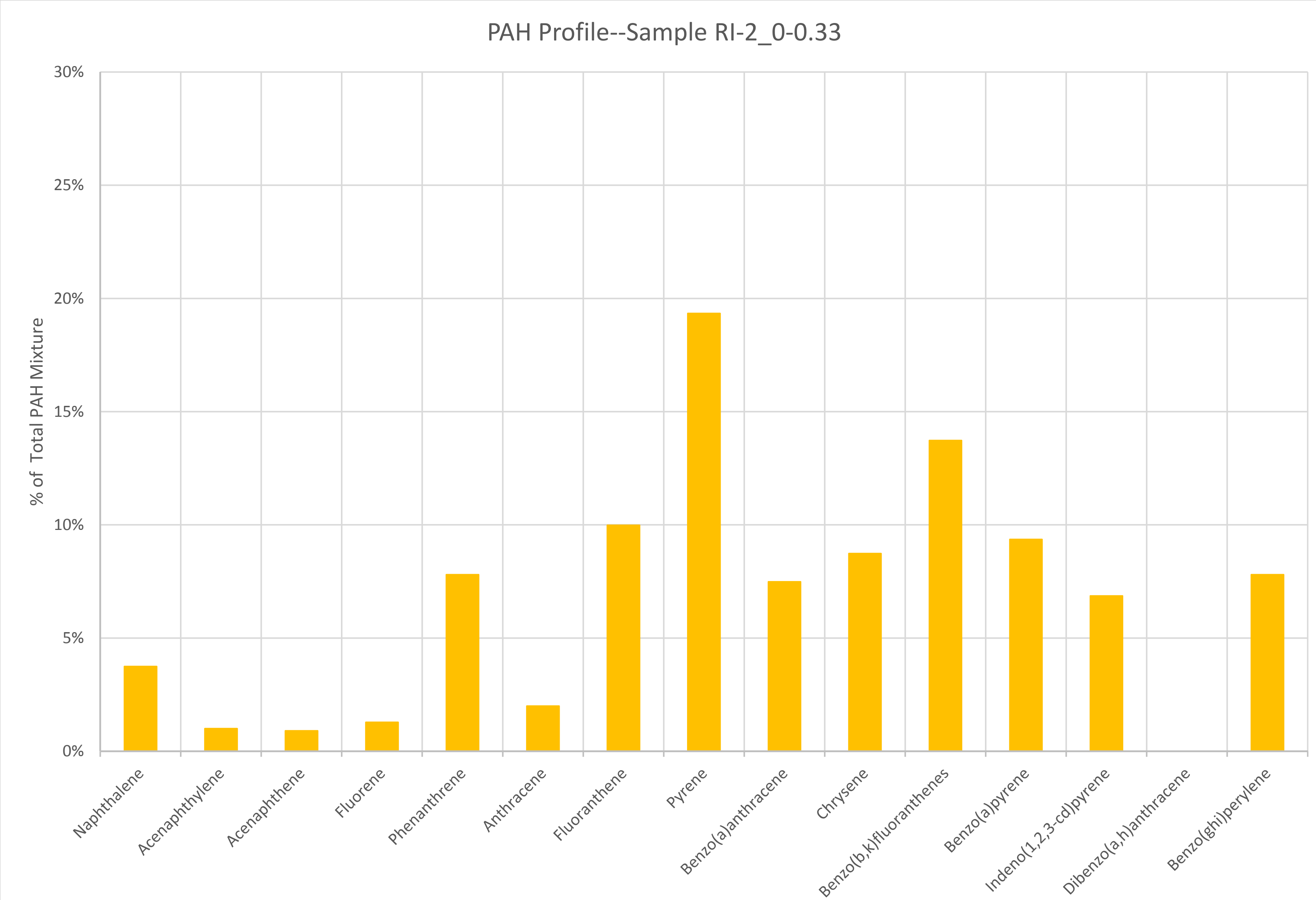

PAH Profile--Sample RI-2_0-0.33
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-2

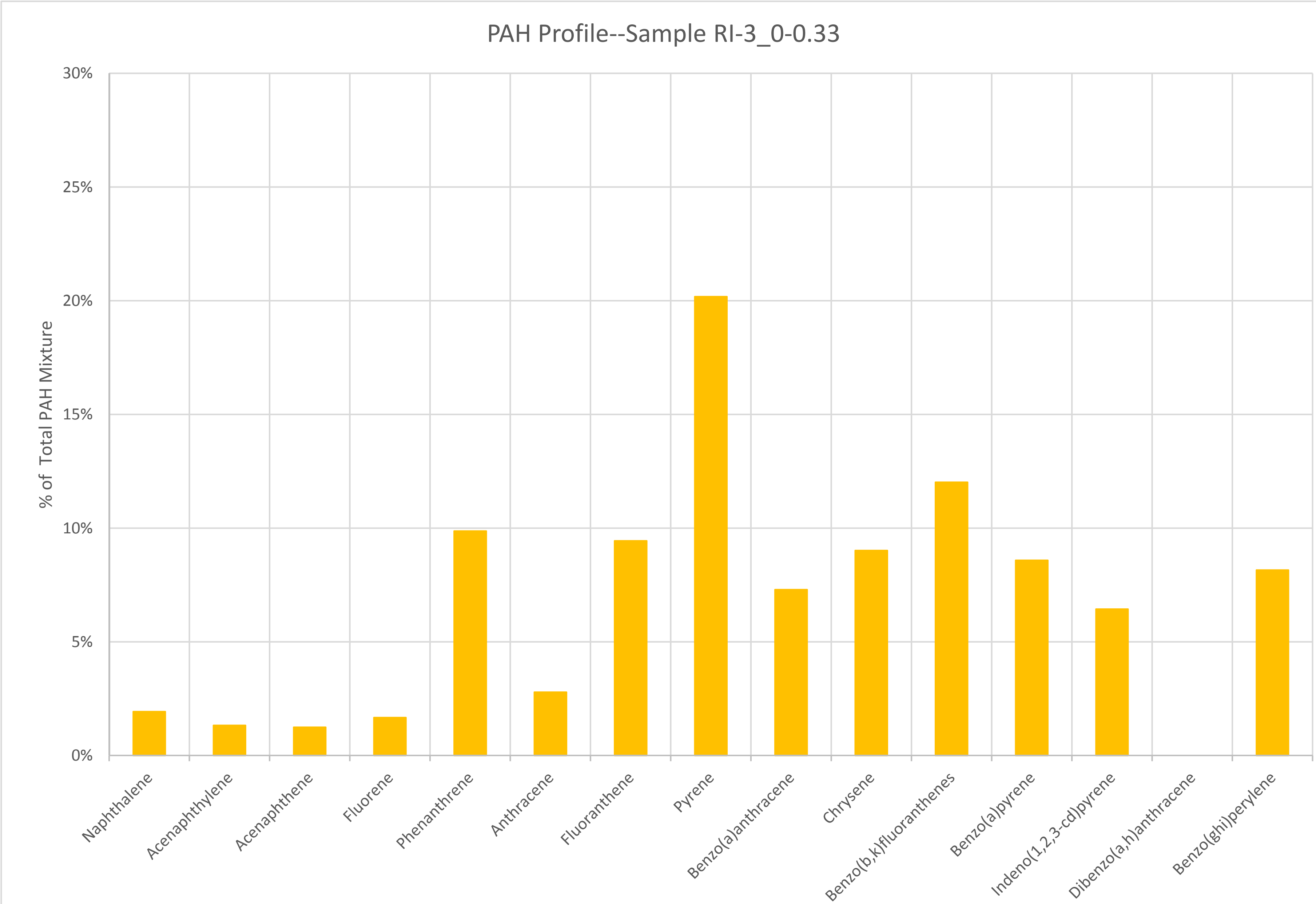

PAH Profile--Sample RI-3_0-0.33
30%
25%
20%
15%
10%
5%
0%
% of Total PAH Mixture
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-3

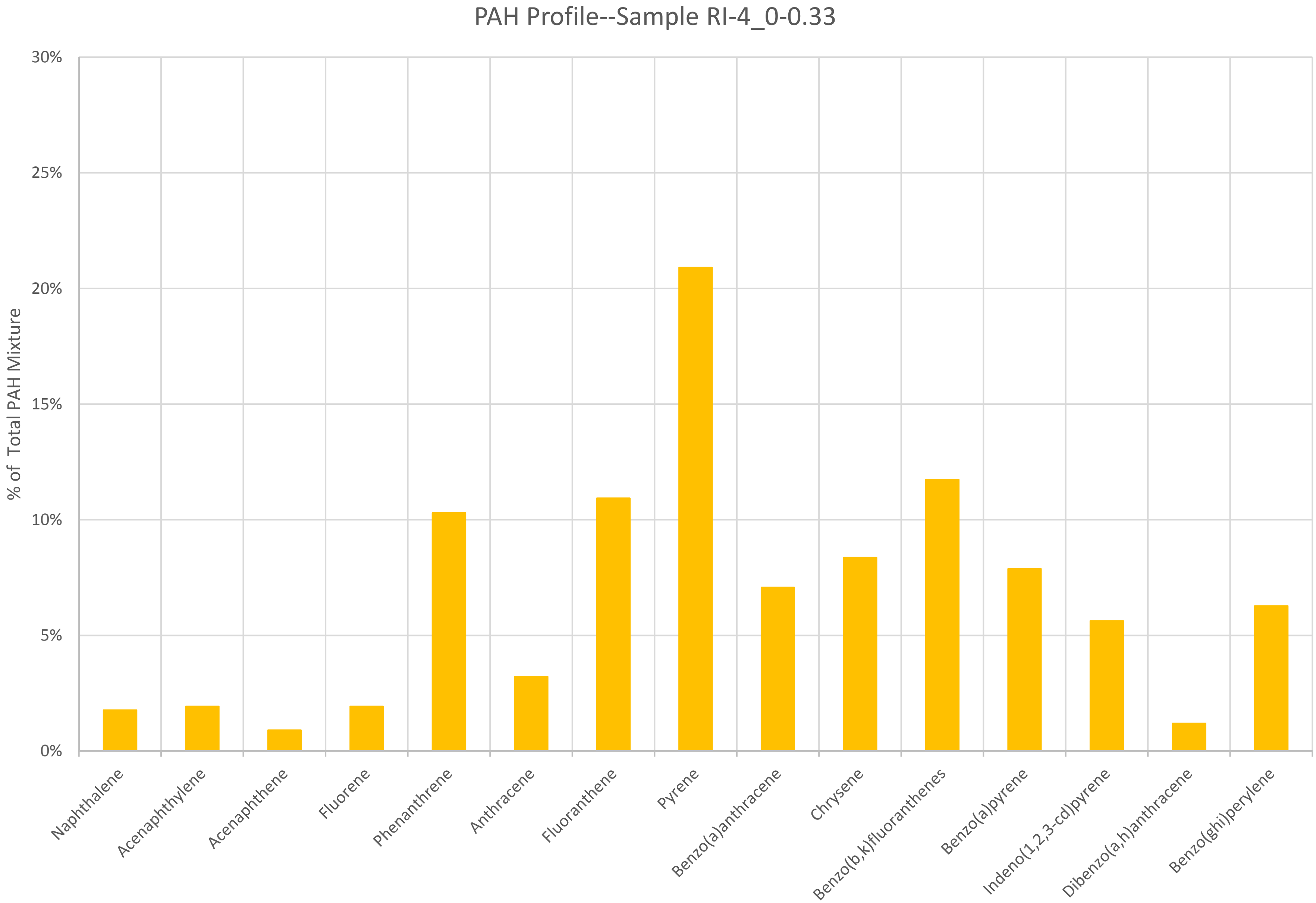

PAH Profile--Sample RI-4_0-0.33
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-4

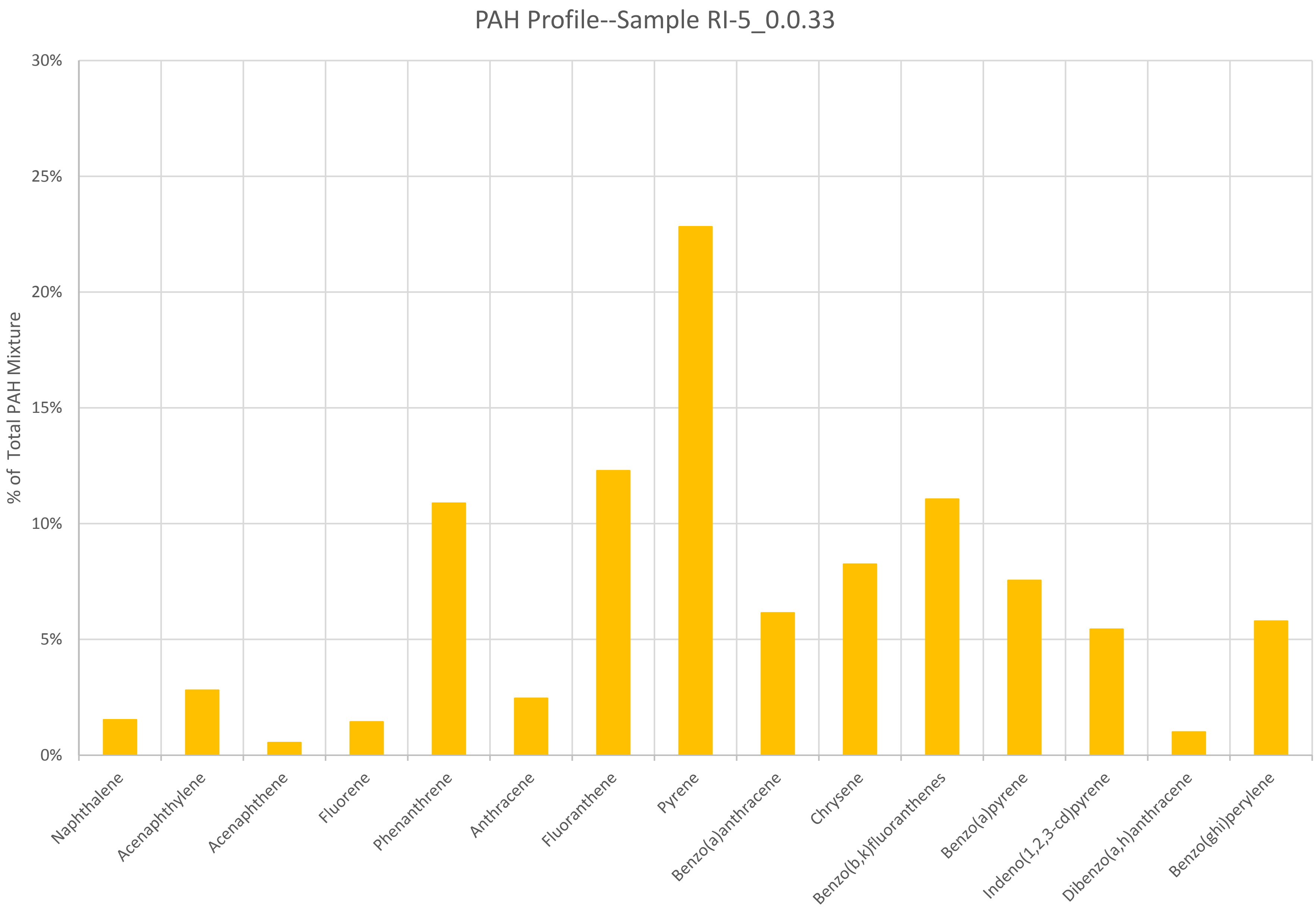
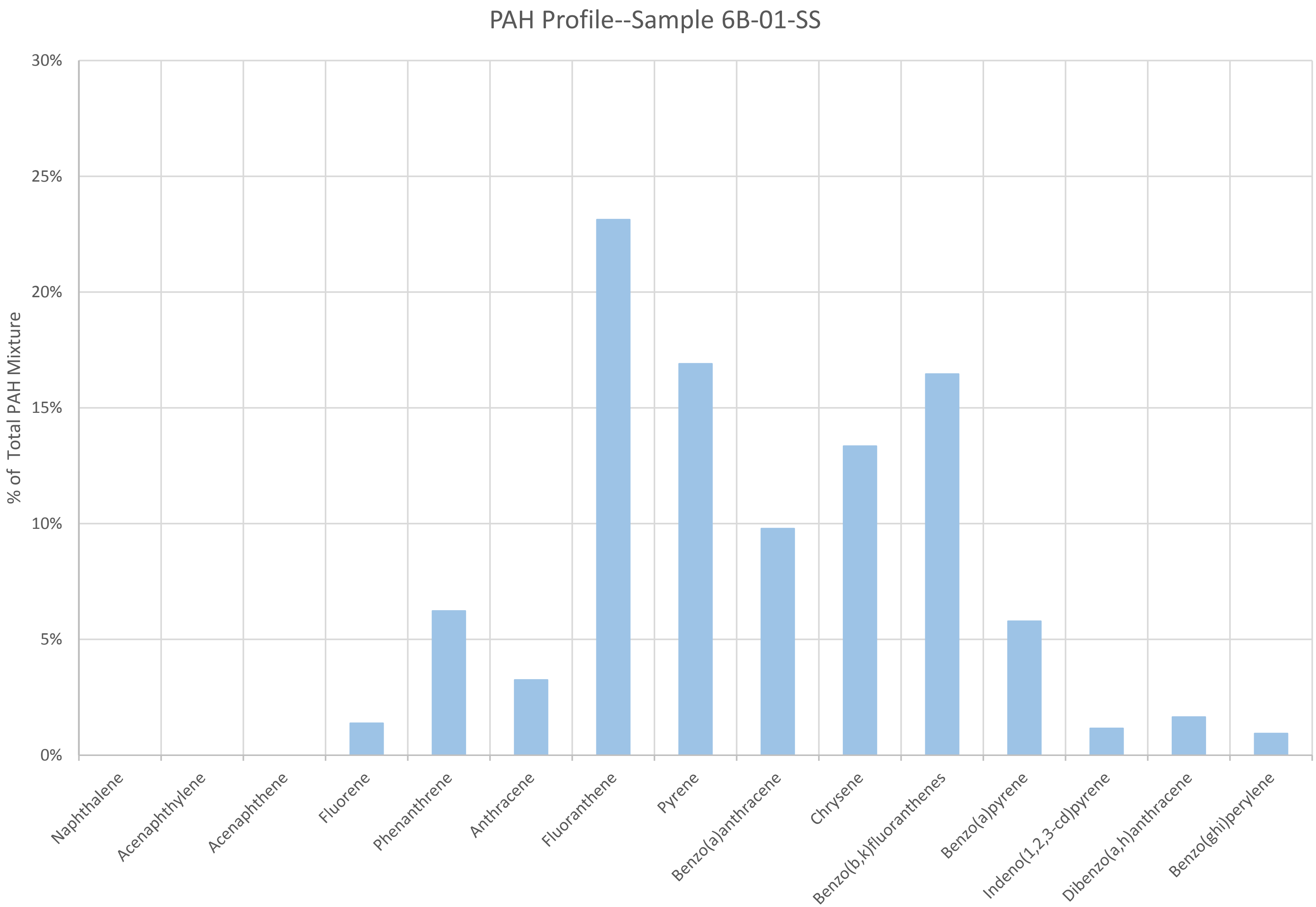

PAH Profile--Sample RI-5_0.0.33
30%
25%
20%
15%
10%
5%
0%
% of Total PAH Mixture
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-5


PAH Profile--Sample 6B-01-SS
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
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Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-6

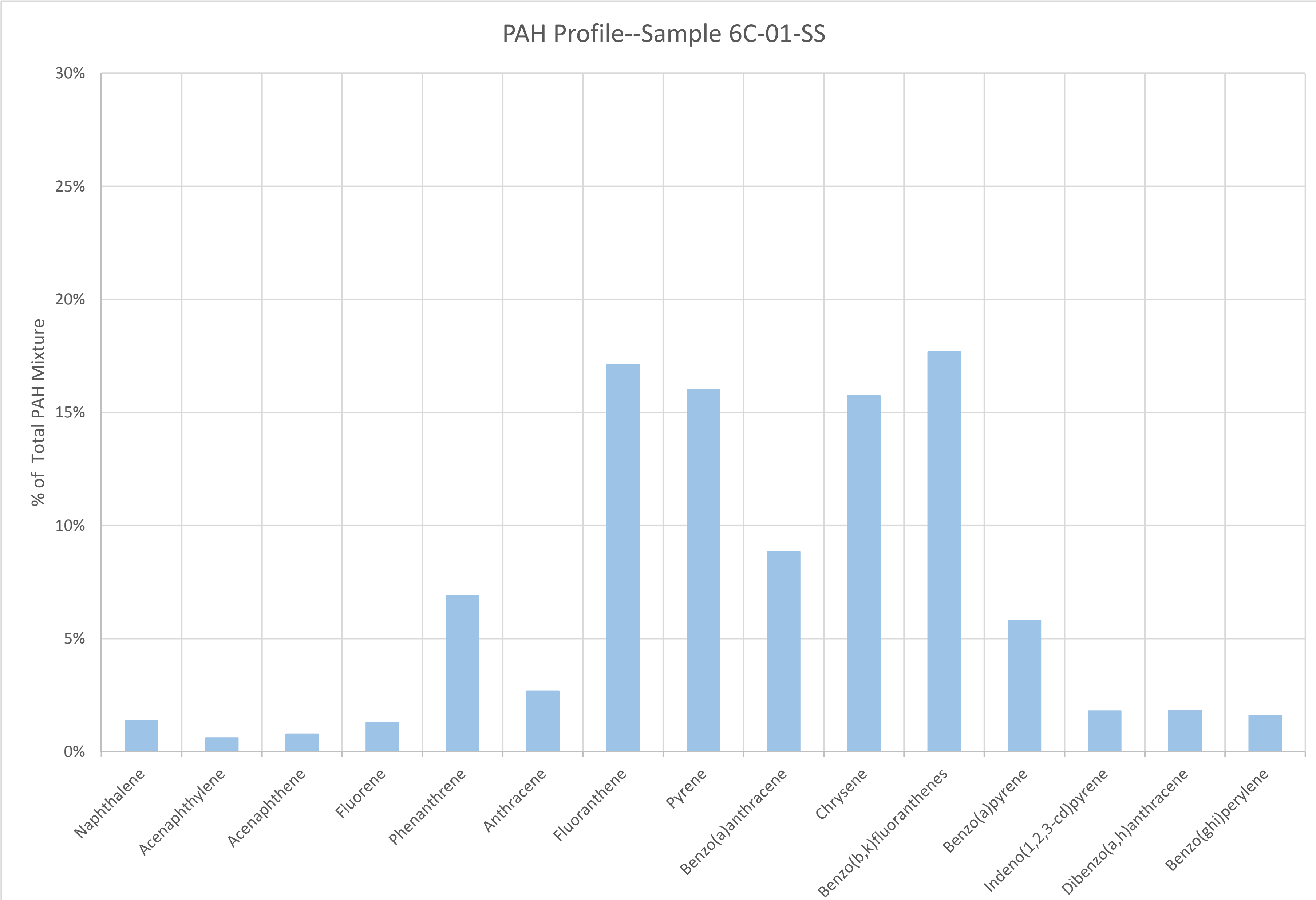
PAH Profile--Sample 6C-01-SS
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-7

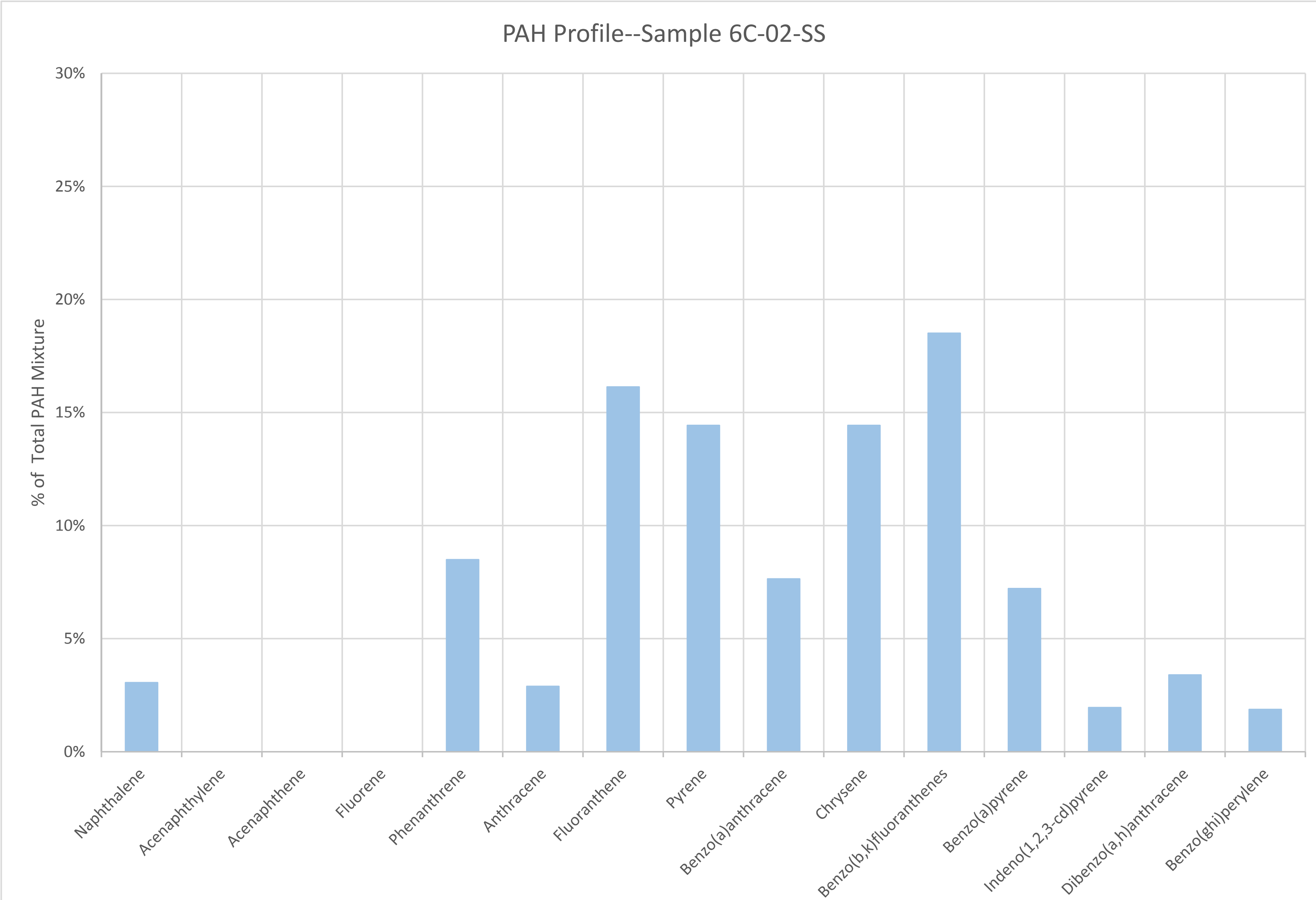
PAH Profile--Sample 6C-02-SS
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-8

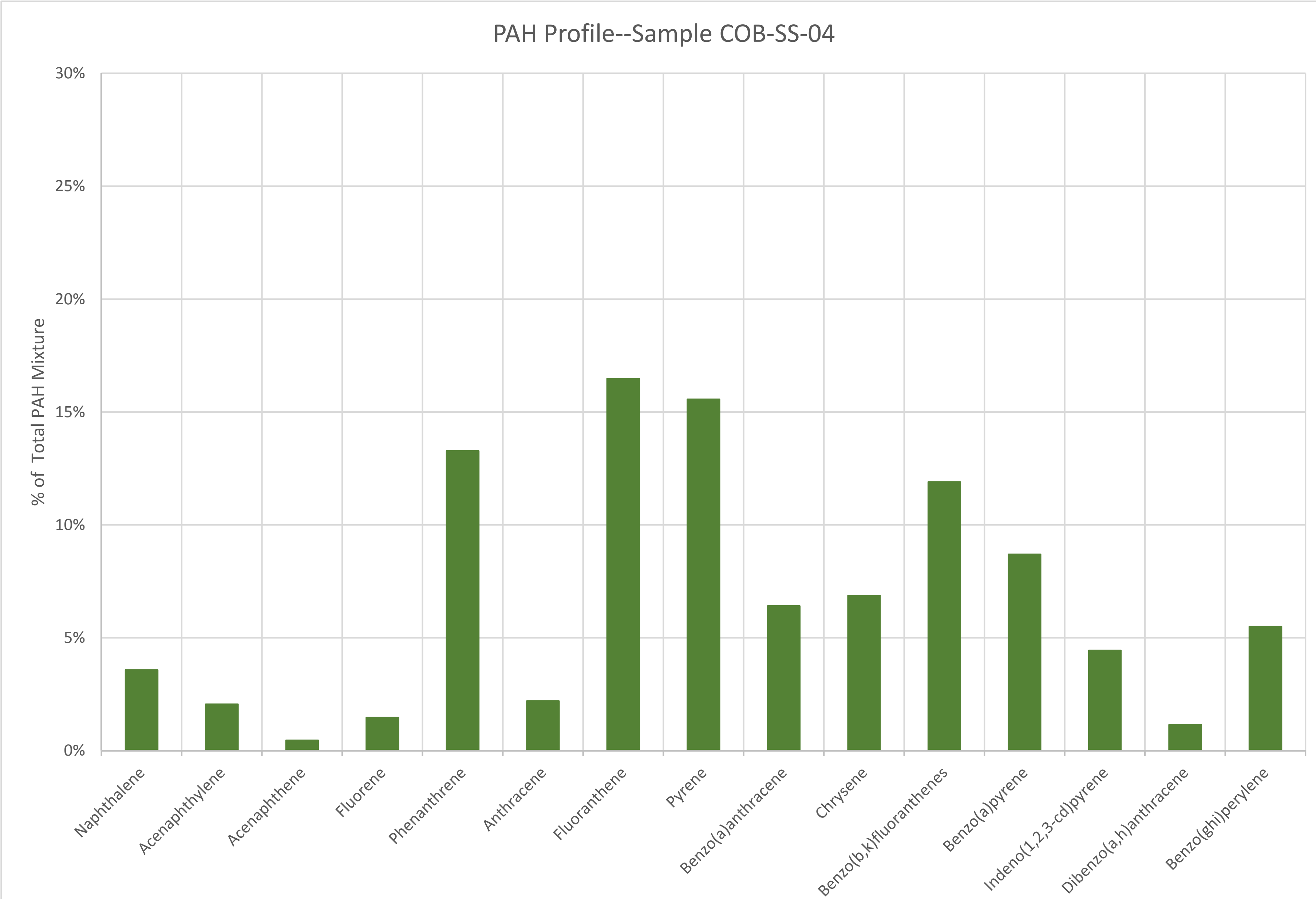
PAH Profile--Sample COB-SS-04
30%
25%
20%
15%
10%
5%
0%
% of Total PAH Mixture
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-9

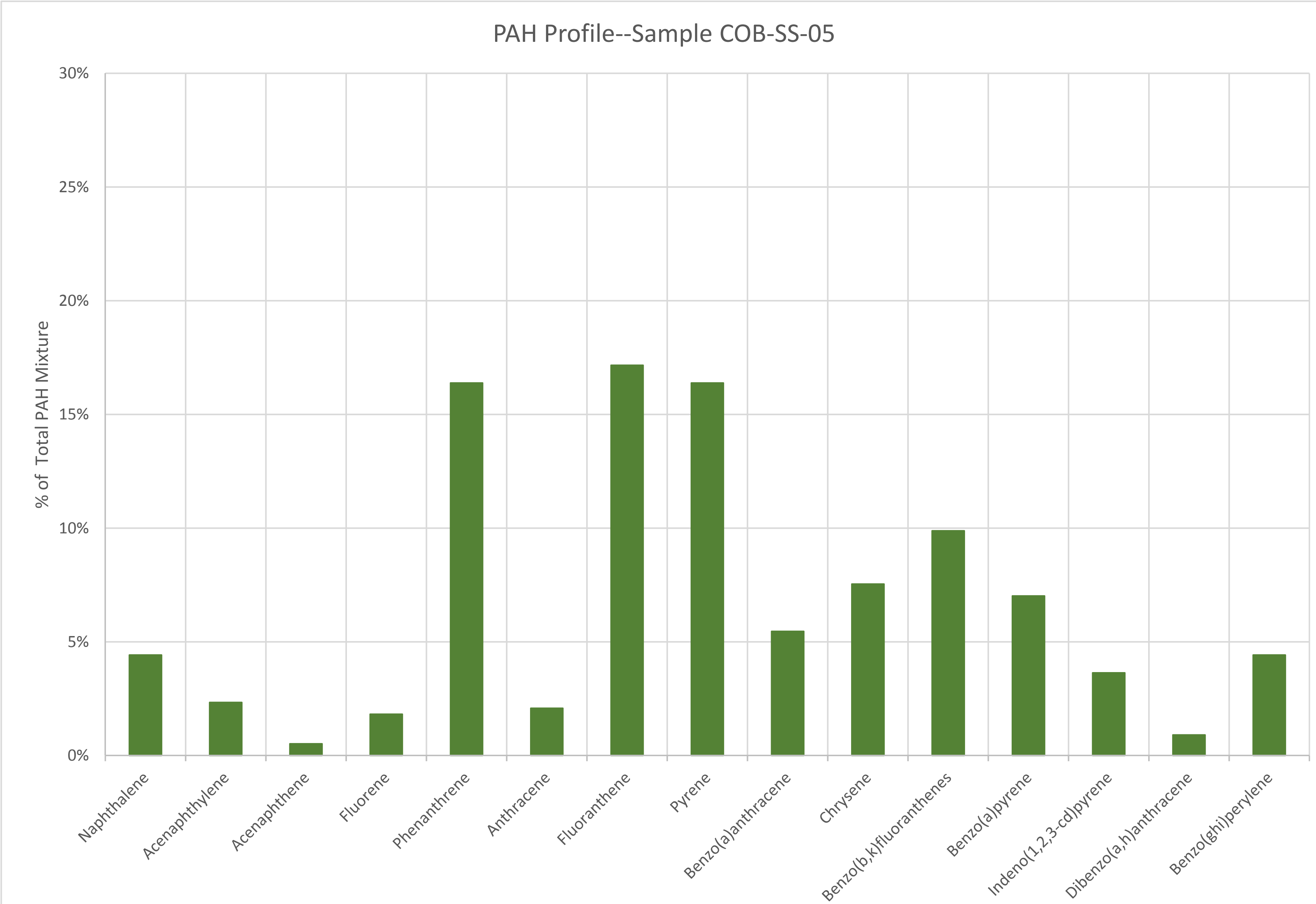
PAH Profile--Sample COB-SS-05
% of Total PAH Mixture
30%
25%
20%
15%
10%
5%
0%
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b,k)fluoranthenes
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

Figure G-10

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# APPENDIX B
## Marine Unit Recontamination Evaluation and Updated Cleanup Level for Dioxins and Furans

**(Originally prepared and provided as Appendix I of the Final R.G. Haley International Corporation Site Engineering Design Report, May 13, 2022)**

## APPENDIX I
## R.G. HALEY MARINE UNIT RECONTAMINATION EVALUATION AND UPDATED CLEANUP LEVEL FOR DIOXINS AND FURANS

### Introduction

The R.G. Haley Site (Haley Site or Site) is located on the northeastern shore of Bellingham Bay, Bellingham, WA (Figure 1). The Haley Site is comprised of an Upland Unit and a Marine Unit, and is currently undergoing cleanup planning and design according to the Model Toxic Control Act (MTCA; Chapter 173-340 WAC) and the Sediment Management Standards (SMS; Chapter 173-204 WAC) for contaminated upland soil, groundwater, air and sediment. Following completion of a remedial investigation and feasibility study, a cleanup action plan (CAP) was published by the Washington State Department of Ecology in April 2018. The CAP specified the cleanup standards (both the cleanup levels and points of compliance) for each medium along with areas requiring cleanup, what the cleanup action will be and how the cleanup will be implemented.

For dioxins and furans, the CAP set the sediment cleanup level (SCL) for the Marine Unit at the regional background-based Cleanup Screening Level (CSL) of 15 nanograms per kilogram (ng/kg), expressed as the toxic equivalent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TEQ), without a recontamination evaluation to provide the rationale for adjusting the SCL up from the PQL-based Sediment Cleanup Objective (SCO) of 5 ng/kg TEQ. As part of Ecology's review of the Engineering Design Report (EDR), they requested a recontamination evaluation for dioxins and furans to attain consistency with the SMS.

This appendix presents the recontamination evaluation and an updated SCL for dioxins and furans based on the results of the evaluation. The following sections describe the regulatory framework for adjusting the SCL, how Ecology established regional background in Bellingham Bay and the lines of evidence that indicate post-construction recontamination of the Marine Unit. Additionally, the following sections describe the basis for adjusting the dioxin and furan SCL up from the SCO and the updated dioxin and furan SCL.

### Regulatory Framework

According to SMS, the SCO is the sediment quality goal, but the SCL may be adjusted up to, but not higher than, the CSL based on an evaluation of technical possibility and net adverse environmental impact (WAC 173-204-560[2][a][ii]). SCUM (Chapter 7, Section 7.2.3.2) states that "technically possible" includes being implemented in a reliable and effective manner that is dependent on site-specific factors such as the ability to maintain the SCO after construction. SCUM (Chapter 7, Section 7.2.3.2) also states that, recontamination from diffuse sources not under the authority or responsibility of the PLP should be considered to determine if the SCO can be maintained.

### Bellingham Bay Regional Background

Ecology established regional background concentrations for dioxins and furans (15 ng/kg TEQ) and several other contaminants in Bellingham Bay in 2015 in support of the Bellingham Bay Demonstration Pilot, a program addressing the comprehensive cleanup of the bay and involving eight sediment cleanup sites. Surface sediment samples were collected in the regional background Area of Interest (AOI) determined to be outside of the direct influence of known sources including cleanup sites, active or historical sources or dredge material disposal sites (Figure 2). Intertidal areas or those areas representative of natural background concentrations were also excluded from the AOI. The resulting data underwent data quality evaluations and statistical analysis prior to calculating a background value according to Ecology procedures. Details of the derivation of regional background for Bellingham Bay are provided in Ecology's report (2015).

## Lines of Evidence

There are multiple lines of evidence that establish the potential for recontamination at the Marine Unit including the potential for sediment erosion or resuspension from the regional background AOI outside of the Marine Unit boundary and transport to the Marine Unit by currents within Bellingham Bay. In addition, there is recent empirical evidence of recontamination in the vicinity of the Marine Unit.

### Sediment Erosion, Resuspension and Transport

There are several natural forces that can erode or resuspend and transport sediment to the Marine Unit. Storm-generated waves are responsible for eroding shorelines and sediment in Bellingham Bay and causing transport of eroded materials. Both breaking waves and the orbital velocities from storm waves have sufficient energy to resuspend and move sediment. Both deep and shallow currents transport sediment either as suspended particles or bed load. Fine-grained sediment is frequently transported as suspended particles in currents where coarse-grained sediments are often moved by those same currents along the bottom.

Bottom currents in Bellingham Bay are relatively consistent throughout the year and velocities within the bay range from 4 to 18 centimeters per second (cm/sec) with a maximum velocity of 40 cm/sec (Colyer 1998 [In] RETEC 2006). A velocity of 20 to 30 cm/sec is generally required to erode fine-grained (i.e., clay, silts and fine sands) sediment particles (Downing 1983). Based on the regional background study, sediment in the AOI is predominantly in the clay and silt range[1] and susceptible to erosion and transport. Therefore, sediment present in the regional background AOI can be resuspended by bottom currents. See the Resuspension and Sedimentation section below for further discussion of resuspension.

Once fine-grained sediment particles are suspended, the particles can be transported by weaker currents. Transport distances are a function of the size of the particles and the strength and direction of the current.

Typical shallow surface currents in the inner bay are much slower ranging from 2 cm/sec to 10 cm/sec with a maximum of 16 cm/sec (Colyer 1998 [In] RETEC 2006). The typical, slower shallow surface currents within the inner bay allow deposition and accumulation of fine-grained sediment in this portion of the bay including the Marine Unit. The results from hydrodynamic modeling conducted by Coast & Harbors Engineers Division of Mott/McDonald (CHE) (EDR Appendix E) suggest that tidal currents in the Marine Unit do not exceed 6 cm/sec.

The forces created by storm-generated waves are primarily responsible for shoreline and nearshore erosion in Bellingham Bay. Winds from the prevailing storms typically originate from the south/southwest, creating waves up to three meters in height near the shore. Shoreline erosion from storm waves is evidenced by the

[1] Thirty out of 34 surface sediment samples were characterized by greater than 90 percent fines.

historical migration of shorelines in Bellingham Bay and the need for shoreline armoring throughout the inner bay.

CHE conducted wave analysis and numerical modeling to support cap design for the Marine Unit (EDR Appendix E). The results of the modeling show that erosion and transport of sediment from storm-generated waves could occur up to the depths evaluated (approximately -20 feet NAVD88). CHE also evaluated changes in sea floor bathymetry at the Cornwall Landfill and Haley sediment units to support remedial design (CHE 2019). The results of the evaluation provide evidence of sediment transport along the bottom to depths greater than -20 feet NAVD88 (Figure 3). Elongated wave-like forms both parallel and perpendicular to the shoreline are evident in Figure 3 and are likely from bottom currents and storm-generated waves periodically moving sediment along the bottom. The evaluation also identified areas of accretion and erosion over an 8-year period between 2007 and 2015. Sediment appears to be accumulating over much of the area evaluated with limited areas of erosion.

The information pertaining to currents in Bellingham Bay and from wave modeling and sediment accretion in the vicinity of the Cornwall and Haley sediment units identifies that sediment erosion and transport are occurring. The regional background AOI is adjacent to the Marine Unit and extends into the inner bay. Because the AOI adjacent to the Marine Unit experiences similar hydrodynamic conditions and exposure to storms, sediment erosion and transport from the AOI to the Marine Unit is highly likely.

#### Resuspension and Sedimentation

There is additional evidence of sediment erosion, resuspension and transport based on the sedimentation and resuspension evaluation conducted as part of the 2000 RI/FS for Whatcom Waterway (Anchor and Hart Crowser 2000). Several sediment traps (HC-ST-100 and HC-ST-101) were deployed in the inner bay within the regional background AOI (Figure 4) for three, four-month periods to evaluate gross sedimentation rates under various conditions. Gross sedimentation ranged from 7.85 centimeters per year (cm/yr) to 21.8 cm/yr and averaged 13.8 cm/yr[2].

Two cores (HC-NR-100 and HC-NR-101), which were co-located with the sediment traps, were used to measure net sedimentation. Rates of sediment accumulation over time were based on decay rates of two radioisotopes (lead-210 and cesium-137). Mercury depth profiles and depth to native sediment in historical dredging prisms were two other lines of evidence evaluated to determine rates of accumulation. Results among the first three methods (two radioisotope dating methods and chemical profiling) to measure net sedimentation had reasonable agreement so results were averaged. Net sedimentation estimates ranged from 1.1 cm/yr to 3.4 cm/yr; the overall average was 1.6 cm/yr.

Resuspension rates (as a percent) were calculated using both gross sedimentation rates and net sediment accumulation over time measured at the co-located traps and cores (gross – net/gross = percent resuspension). Resuspension rates ranged from 81 to 93 percent with an average of 88 percent. These results confirm that bottom sediments in the regional background AOI are highly likely to be resuspended and transported to other locations including the Marine Unit.

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[2] Based on five data points.

### Current Patterns and Transport

The current direction in Bellingham Bay, both shallow and deep, is variable. Tidal exchanges[3]; wind direction, duration, magnitude and fetch; riverine discharges, water depth and shoreline configuration all influence the complex circulation of water in Bellingham Bay. Deep flow generally oscillates from inbound to outbound based on tide and nearshore currents flow in both clockwise and counterclockwise directions following shorelines depending on winds and river flows.

The dominant current direction has been reported to be an oscillating north-south longshore flow (USACE 1997) but has also been reported to be a dominant clockwise flow (Colyer 1998). Eddies have been reported to form, particularly in the inner bay, depending on wind speed and direction, freshwater input, and strength of the tidal exchange (Colyer 1998).

Modeling by CHE indicates current reversals with ebb and flood tides in the vicinity of the Marine Unit (Figure 2 of EDR Appendix E). The modeling by CHE indicates that a component of the current in and adjacent to the Marine Unit oscillates in a north-south longshore flow as a result of tides. Winds from the south and southwest entrain water at and near the surface, pushing it to the north/northeast towards the inner bay causing return flows that typically flow counterclockwise. Winds from the west and northwest cause surface currents to flow clockwise along the eastern shoreline (Shea et al 1981 [In] RETEC 2006). As a result of the oscillating current directions observed in Bellingham Bay, sediment transported to the Marine Unit is highly likely to originate from regional background AOI.

### Sediment Conditions in Bellingham Bay

Dioxins and furans have been evaluated as part of various sediment investigations in Bellingham Bay over the last 20 years. More recently, Ecology conducted a sediment investigation in 2014 to establish regional background levels of dioxins and furans along with several other chemicals of concern in Bellingham Bay. Surface sediment samples were collected and analyzed for dioxins and furans from 23 locations (BB-08 through BB-30) that were outside the influence of known dioxin and furan sources as part of the investigation (Figure 4). Dioxin and furan concentrations ranged from 2.2 nanogram/kilogram (ng/kg) to 14.4 (average dioxin TEQ at BB-24) ng/kg TEQ. The data were evaluated to determine the representativeness of regional conditions and ultimately a value of 15 ng/kg TEQ was statistically derived (90/90 upper tolerance limit or UTL) from the data to represent regional background in Bellingham Bay (Ecology 2015).

Since that time, other samples have been collected as part of the long-term monitoring for the Whatcom Waterway cleanup (Anchor QEA 2019 and 2020). Five locations (MNR-03 through MNR-05, MNR-07 and MNR-09) in and adjacent to the regional background AOI that were designated monitored natural recovery (MNR) stations (Figure 4) have been sampled twice (2017 and 2019). Dioxin and furan concentrations at these locations were similar for both sampling years and to the regional background data set, ranging from 5.1 ng/kg TEQ to 14.5 ng/kg TEQ as summarized in the following table. The recent MNR data suggest some stability in prevailing conditions in Bellingham Bay in the regional background area.

[3] The tidal range (the difference in elevation between the highest high tide and lowest low tide) in Bellingham Bay is approximately 12 feet.

**WHATCOM WATERWAY DIOXIN TEQ DATA AT MNR LOCATIONS FOR YEARS 1 AND 3**

| Location | Year 1 | Year 3 |
|---|---|---|
| MNR-03 | 6.1 | 6.6 [a] (8.1, 5.1) |
| MNR-04 | 5.1 [a] (6.9, 3.3) | 9.3 |
| MNR-05 | 10.2 | 10.6 |
| MNR-07 | 14.5 | 12.1 |
| MNR-09 | 11.6 | 13.6 |

Note:

a. Value is an average of two field replicates

### Sediment Conditions in the AOI Adjacent to the Marine Unit

Based on the lines of evidence discussed above, the regional background AOI[4] adjacent to the Marine Unit represents the most likely source of resuspended sediment that may recontaminate surface sediment following remediation. The adjacent AOI area identified as the Recontamination Evaluation Area on Figure 5, was evaluated to determine the level of recontamination that may occur within the Marine Unit from the AOI. The area selected as the source of recontamination accounts for proximity of the Marine Unit to the AOI, current and storm wave resuspension in the shallower portion of the AOI adjacent to the Marine Unit, and transport vectors (i.e., from the southwest to the northeast) from the AOI to the Marine Unit based on current oscillation within the Bay adjacent to the Marine Unit.

A dioxin and furan surface-area weighted average concentration (SWAC) was calculated for the Recontamination Evaluation Area. The SWAC was prepared using GIS interpolation[5] of dioxin and furan TEQ concentrations in Bellingham Bay. The data used are shown on Figure 4, and were compiled from Ecology's Environmental Information Management (EIM) database and published reports. The data consist of the most recent surface sediment (0 to 12 cm) data for each of the areas shown in Figure 4. The data set and study area boundaries are consistent with the data used for evaluation of dioxin and furans for the Whatcom Waterway Site. The entire data set underwent GIS interpolation which resulted in a dioxin and furan TEQ concentration being assigned to each square foot of area encompassed by the data set. Then the concentration values for each square foot comprising the Recontamination Evaluation Area shown in Figure 5 were "clipped" from the larger interpolation and used to calculate the SWAC for the Recontamination Evaluation Area. The resulting dioxin SWAC is 13.1 ng/kg TEQ and represents the most likely level to which surface sediment within the Marine Unit will be recontaminated by sediment from the Recontamination Evaluation Area.

#### Empirical Evidence of Recontamination

There is empirical evidence of recent recontamination based on the monitoring of a dredged and capped area in the Whatcom Waterway Site (Anchor QEA 2018, 2019 and 2020). Site Unit 1C near the mouth of the waterway and adjacent to the regional background AOI (Figure 5) was dredged to remove

[4] The regional background AOI overlaps with the outermost portion of the Marine Unit. The overlap area was not included in the recontamination evaluation area.

[5] Interpolation was conducted using an inverse-distance weighted geospatial model, with a power of 5, maximum number of neighbors of 4, minimum number of neighbors of 2, four sectors rotated 45 degrees and a 500-foot diameter search area (reach).

contamination. As with all dredging, a thin layer of contaminated dredge residuals settled on top of the clean dredged surface upon completion of dredging. The dioxin and furan concentrations in the dredged residuals ranged from 2.1 ng/kg to 26.2 ng/kg TEQ so a cap was placed over the dredged area to cover the residuals. Confirmation samples collected from the cap placed over the dredge residuals showed that the new surface was below natural background (5 ng/kg TEQ) at five of the six sampling locations with one location being slightly above regional background (16.3 ng/kg TEQ versus 15 ng/kg TEQ). Monitoring in the first (2017) and third (2019) years following dredging and placement of the residual cap measured concentrations of 13.2 ng/kg TEQ and 13.8 ng/kg TEQ at monitoring location P1CM-02 located near the center of the previously dredged area at the mouth of the waterway (Figure 5). Concentrations measured in Site Unit 1C are very similar to the upper values reported in the regional background data set and suggest that recontamination is occurring to levels similar to the regional background concentration at Site Unit 1C located adjacent to the regional background area.

#### Regional and Local Sources of Dioxins and Furans

The persistence and relative stability of dioxin and furan concentrations in surface sediment in the Bellingham Bay regional background area is likely due to the presence of uncontrolled or unknown sources within the surrounding area. The eastern and northern portions of the bay are within urban and industrial areas of the City. As with other urban and industrial areas, there are current and historical sources of dioxin and furans.

In Bellingham, current and/or historical sources include burning of wood (residential heating, hog fuel, forest fires), vehicle emissions, incineration of waste, pulp manufacturing, wood-treating operations, cement kilns, and other sources. Except for identified cleanup sites where dioxins and furans are a contaminant of concern, other current point sources are unknown. The existence of ubiquitous sources remains challenging for control of dioxins and furans in Bellingham Bay and throughout the Puget Sound region.

As a result of current and historical releases, dioxins and furans are a ubiquitous contaminant in soil in urban environments. A study of residential soil in Bellingham as part of the Oeser Site cleanup (START 2002) reported concentrations ranging from 2.7 ng/kg to 34.8 ng/kg TEQ in areas considered background. These concentrations fall within the range (7.5 ng/kg to 36 ng/kg) of dioxin and furan TEQs reported in residential soil from Seattle neighborhoods (Ecology 2011).

A historical investigation of the Little Squalicum Creek watershed that had been impacted by the Oeser Site suggests that riparian and wetland soils as well as stream sediment in the urban areas are a potential source of contamination to the bay. Background samples in the Little Squalicum stream corridor had dioxin and furan TEQ concentrations of 12.6 ng/kg and 14.0 ng/kg (data from EIM; accessed 4/29/21).

Numerous sources of dioxins and furans exist that are not under the control of the City including air emissions, surface water, non-municipal stormwater runoff and erosion of soil. Dioxin and furan emissions and transport from non-City sources likely represents a long-term source to the bay and contribution to dioxin and furan concentrations in regional background.

### Updated Dioxin and Furan Cleanup Level for the Marine Unit

The evaluation of recontamination identifies that waves and currents within Bellingham Bay are sufficient to cause resuspension and transport of sediment to the Marine Unit from the Recontamination Evaluation

Area. The dioxin and furan concentrations in the regional background AOI adjacent to the Marine Unit range between approximately 6 ng/kg TEQ and 15 ng/kg TEQ based on recent data. Data from sediment samples collected in 2017 and 2019 suggest there is some temporal stability in the sediment quality conditions in the AOI when compared to the 2014 regional background study conducted by Ecology. Evaluation of the recontamination lines of evidence suggests that the regional background value established by Ecology continues to be reasonable upper bound concentration representing surface sediment conditions in the bay.

The resuspension and transport of sediment from the Recontamination Evaluation Area is sufficient to recontaminate sediment at the Marine Unit following remediation. The more detailed evaluation of the Recontamination Evaluation Area, which would contribute to recontamination of the Haley site, concludes that a value of 13 ng/kg TEQ represents a likely recontamination level from this portion of the AOI. Based on the results of the recontamination evaluation, the dioxin and furan PQL-based SCO of 5 ng/kg TEQ cannot be maintained following construction. Therefore, in accordance with the SMS and SCUM, the SCL for the Marine Unit is adjusted up to 13 ng/kg TEQ, slightly lower than the regional background-based SCL of 15 ng/kg TEQ previously identified in the CAP. There is uncertainty in any estimate of future concentrations in surface sediment at the Haley Site. The timing and duration of remediation of other sites in the bay will affect what can be maintained over time. Long-term monitoring will document compliance of the remedy with the cleanup level and will allow assessment of the rate of recovery and achievement of the long-term goal for Bellingham Bay. The SCO remains the long-term goal to be attained through pollution prevention and toxics reduction initiatives over a longer timeframe than is applied to the cleanup of the Haley Site.

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Attachments:

Figure 1. Vicinity Map

Figure 2. Regional Background Area of Interest

Figure 3. Sediment Accretion 2007 to 2015

Figure 4. Recent Dioxin/Furan Data Used in Recontamination Evaluation

Figure 5. Recontamination Evaluation Area



W True North S N Project North E

0 1,000 2,000 Feet

Map Revised: 24 September 2021 glohrmeyer

Path: P:\0\0356114\GIS\MXDs\035611408_F01_VicinityMap.mxd

Reference: Whatcom County GIS, City of Bellingham GIS, Aerial from Esri, 2017.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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Projection: NAD 1983 UTM Zone 10N

## Vicinity Map

R.G. Haley Site
Bellingham, Washington

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**Figure 1**

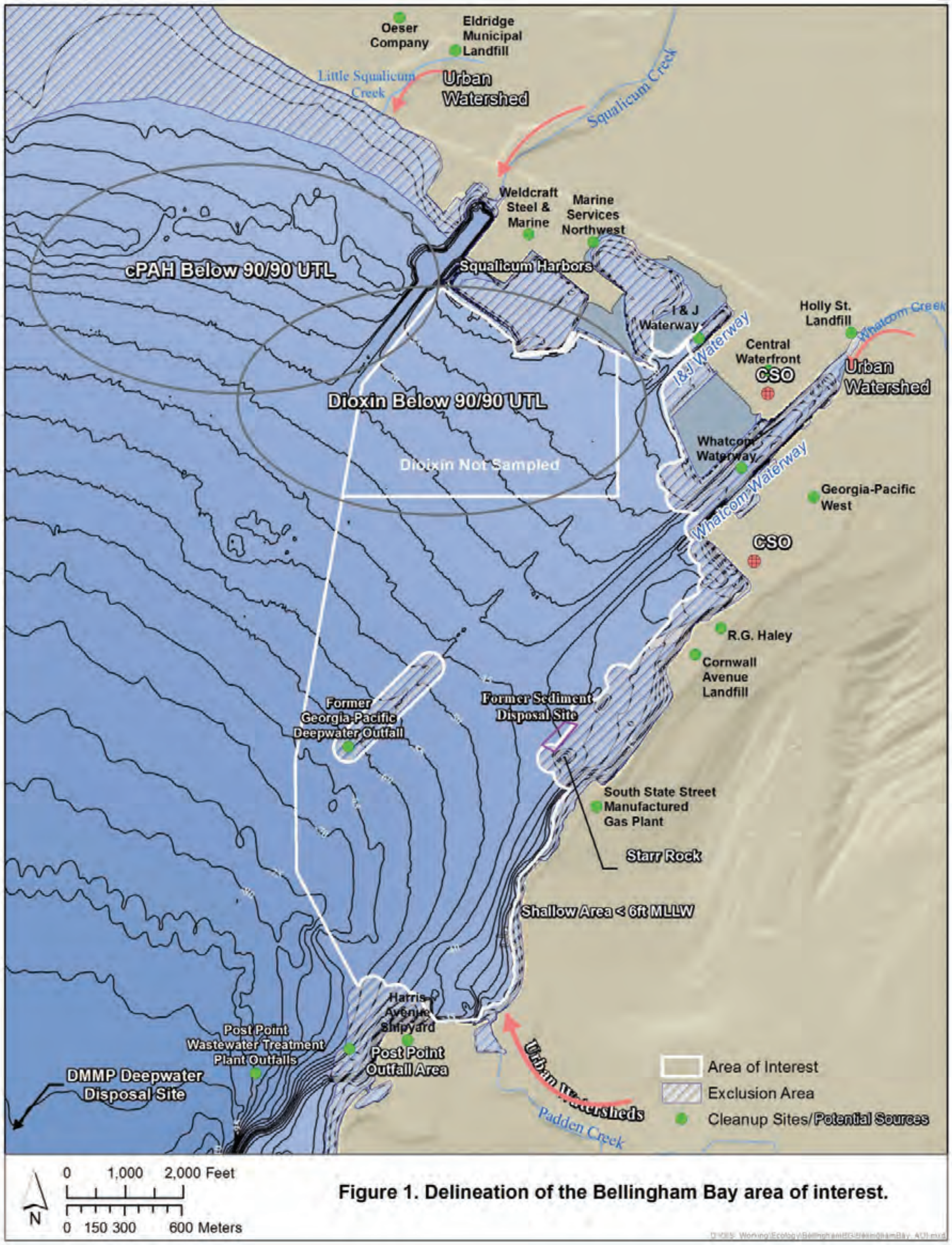


Figure 1. Delineation of the Bellingham Bay area of interest.

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2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electr ored by GeoEngineers, Inc. and will serv d of this communication.

Data Source: Ecology 2015. Bellingham Bay Regional Background Sediment Characterization, Bellingham WA. Final Data Evaluation and Summary Report. Publication No. 15-09-044. February 27, 2015.

**Regional Background Area of Interest**

R.G. Haley Site
Bellingham, Washington

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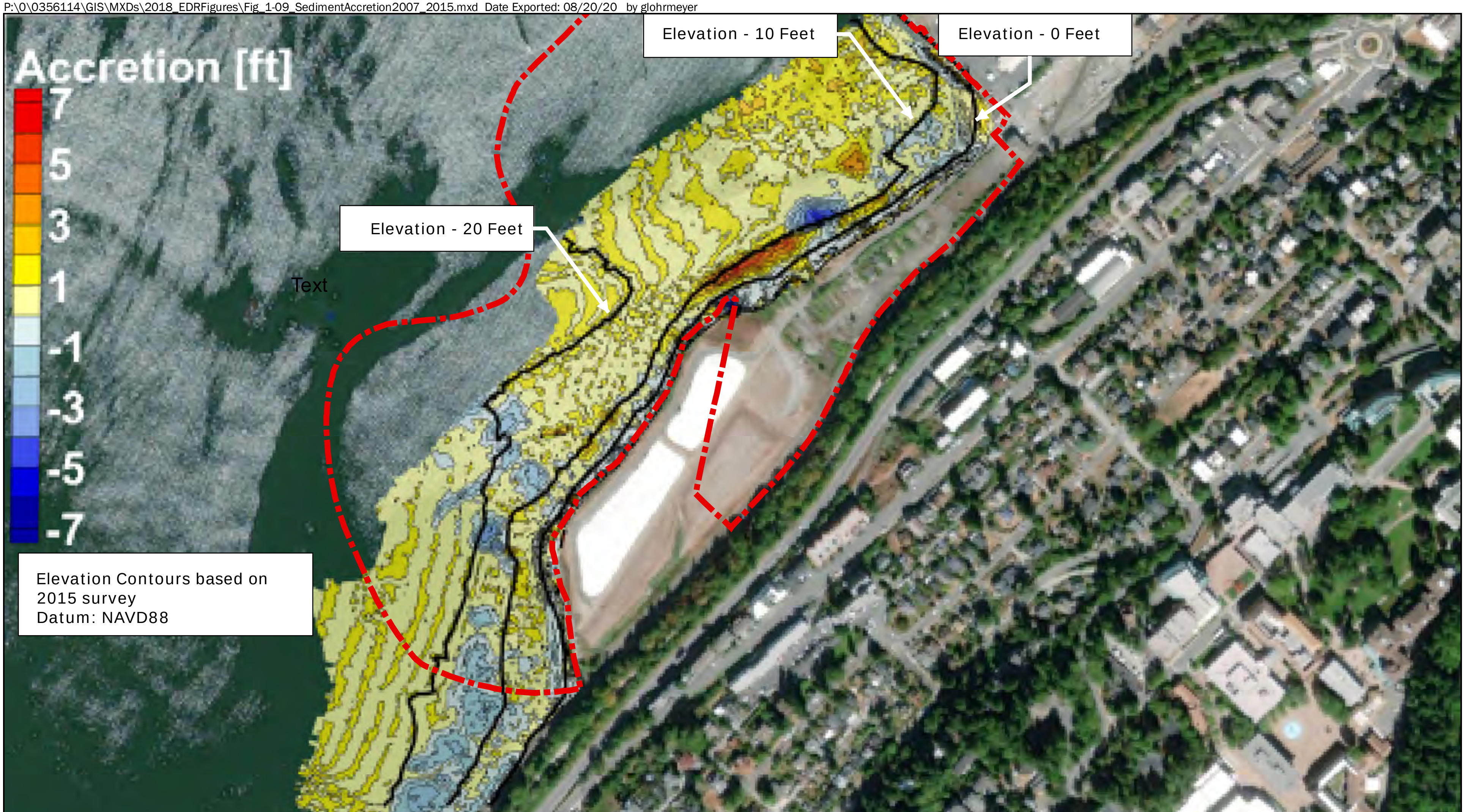
**Figure 2**

P:\0\0356114\Graphics_Misc\Regional Background AOI.indd Exported 6/21/21 by spride

P:\0\0356114\GIS\MXDs\2018_EDRFigures\Fig_1-09_SedimentAccretion2007_2015.mxd Date Exported: 08/20/20 by glohrmeyer

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3. Modified from Mott MacDonald figure presented during April 10, 2019 coordination meeting with the City and the Port.
Accretion determined by Mott MacDonald by subtracting 2007 depths to seafloor from 2015 depths.
Haley Cleanup Area Boundary added for reference.

Projection: NAD 1983 StatePlane Oregon North FIPS 3601 Feet

**Legend**

Haley Cleanup Area Boundary

500 0 500
Feet

N W E S

**Sediment Accretion 2007 to 2015**

R.G. Haley Site
Bellingham, Washington

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**Figure 3**


Notes:

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Data Source: Aerial from Bing.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

**Legend**

- BB-25 11.9 — Sample Designation and Dioxin/Furan TEQ (ng/kg)
- Cap Area
- RG Haley Site Marine Unit
- Whatcom Waterway Site
- South State Street Site Marine Unit
- Regional Background Area of Interest (AOI)
- Dioxin/Furan Exclusion Areas

Sample Year

- 1996
- 2004
- 2008
- 2012
- 2013
- 2014
- 2015
- 2019
- 2020

1,050 0 1,050

Feet

**Recent Dioxin/Furan Data Used in Recontamination Evaluation**

R.G. Haley Site
Bellingham Washington

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**Figure 4**


Notes:
1. The locations of all features shown are approximate.
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Data Source: Aerial from Bing.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

**Legend**

- BB-25 11.9 — Sample Designation and Dioxin/Furan TEQ (ng/kg)
- Recontamination Evaluation Area
- Cap Area
- RG Haley Site Marine Unit
- Whatcom Waterway Site
- South State Street Site Marine Unit
- Regional Background Area of Interest (AOI)
- Dioxin/Furan Exclusion Areas
- Site Unit 1C Dredge and Cap Area

Sample Year
- 1996
- 2004
- 2008
- 2012
- 2013
- 2014
- 2015
- 2019
- 2020

500 0 500
Feet

**Recontamination Evaluation Area**

R.G. Haley Site
Bellingham Washington

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**Figure 5**

P:\0\0356114\GIS\0356114_Project.aprx\0356114008_F05_RecontaminationEvaluationArea Date Exported: 10/18/21 by glohrmeyer